1955

Sixty-Eighth Annual Report, 1955, of the Tennesse Agricultural Research Station

University of Tennessee Agricultural Experiment Station

Sixty-Eighth

ANNUAL REPORT

1955

of the

TENNESSEE AGRICULTURAL
EXPERIMENT STATION

THE UNIVERSITY OF TENNESSEE
KNOXVILLE

SIXTY-EIGHTH

ANNUAL REPORT
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Tennessee Agricultural Experiment Station

THE UNIVERSITY OF TENNESSEE
KNOXVILLE

Letter of Transmittal

Knoxville, Tennessee, January 1, 1956

To His Excellency, Frank G. Clement, Governor of Tennessee:

Sir: I have the honor to transmit herewith, on behalf of the Board of Trustees of the University of Tennessee, a report of the work and expenditures of the Agricultural Experiment Station for the year 1955. This report is submitted in accordance with the law requiring that the Board having direction of the Experiment Station shall annually submit to the Governor of the State a report of its operations and expenses.

Very respectfully,

C. E. BREHM, President

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1955

Introduction

Research in agriculture and home economics, as set forth in this report, is designed to study farm and home problems of most pressing importance to the people of Tennessee and the Nation.

New scientific discoveries have no political or geographical boundaries. Many of the discoveries made in Tennessee have been used in other areas; and, on the other hand, scientists working at other research stations have been of great value to the agriculture of this State. New plants, insecticides, and machines that have been developed at the Tennessee Agricultural Experiment Station are in wide use in other states and countries.

Food, fiber, and shelter are essential to the well-being of the civilized world. Our standard of living has risen along with the trend whereby producers of these essentials declined in number. Within the past few decades the number of people required to work on the farms has been reduced by more than one-half. This released millions of workers to go into manufacturing plants to make other materials that add to the comforts of life.

Research workers have made great progress, but the battle is not won. The increasing population must be fed and clothed. There are still many problems to be solved. For example, plant and animal insects and diseases still take an annual toll from the farmer far greater than the amount of money spent on research.

Research in agriculture and in the home is for the benefit of rural and urban people alike. It is dedicated to making a fuller and more satisfying life for all.

FINANCIAL STATEMENT

THE UNIVERSITY OF TENNESSEE
AGRICULTURAL EXPERIMENT STATION

In account with

The United States Appropriations under the Hatch, Adams, Purnell, and Bankhead-Jones Acts, and Non-Federal Funds, 1954-55

	Federal Funds						Non-Federal Funds
	Hatch	Adams	Purnell	Bankhead-Jones Section 5	Bankhead-Jones Section 9	Title II	
Receipts							
From United States Treasurer	$15,000.00	$15,000.00	$60,000.00	$92,293.90	$268,210.82	$9,571.96	
From Other Sources							$809,648.57
Expenditures							
Personal Service	$14,999.88	$14,999.66	$58,717.87	$83,757.71	$214,020.56	$4,537.15	$429,017.89
Travel			605.32	1,165.24	8,445.30	7.94	27,540.47
Transportation of Things				23.21	172.25		4,004.93
Communication Service	.12	.34	2.31		341.53		8,555.35
Rents and Utility Services				93.70	182.65		13,862.14
Printing and Binding					347.04		2,171.00
Other Contractual Services				1,446.85	2,805.90	10.00	19,186.32
Supplies and Materials			44.50	5,460.78	17,594.28	2,818.80	174,175.00
Equipment			630.00	346.41	24,145.31	975.00	50,858.31
Land and Structures (Contractual)					156.00		80,277.16
Total Expenditures	$15,000.00	$15,000.00	$60,000.00	$92,293.90	$268,210.82	$8,348.89	$809,648.57

Agricultural Economics and Rural Sociology

The year 1955 was one of moderate prosperity to Tennessee farmers. However, it was a year generally characterized by farm production slightly in excess of demand outlets. Consequently, Tennessee farmers were very interested in information which might lead to expanded markets on the one hand or to a lowering of production costs on the other. The research program of the Department of Agricultural Economics and Rural Sociology has been such as to provide needed information on these issues.

Illustrative of the possibilities of expanding markets are the studies that have been made on such things as: effectiveness of the School Lunch Supplementary Milk Feeding Program, as a means of increasing total milk consumption; consumer reaction to various quality factors in broilers; the possibilities of expanded outlets for nursery products. Illustrative of the research on reducing costs are: studies of the economics achieved by machine-capping as compared to hand-capping of strawberries; the possibilities of increasing farm efficiency by reorganization of agriculture in response to outmigration of farm

people; the seasonal pattern of labor requirements of different combinations of farm enterprises; the various means of increasing the rate at which farmers adopt improved farming practices. These contributions are illustrative only, as all the Department's research projects contribute to more efficient farming and more successful marketing.

Special mention should be made of the fact that the National Rural Development Program, by which the problem of very low incomes of rural people in some areas is to be attacked, was started this year. Three counties have been chosen in Tennessee as pilot counties for the investigation of the feasibility of various alternative means of improving rural incomes in such low income areas. The Department has worked closely with the program in the State. Of more importance, however, is the fact that it has, over the past several years, done substantial fundamental research on this problem, with the result that the nationwide program has been influenced importantly by the Department's research findings. Work in this area of problems will be continued and probably intensified during the next year.

Research Projects

Marketing Livestock in Tennessee (A Contributing Project to Regional Research Project: SM-7, M. B. Badenhop).

Sub Project 2—An Analysis of Relevant Price Factors and Their Relationship to Slaughter Cattle and Calves with Particular Emphasis on Price-Grade Differentials (M. B. Badenhop).

Type and Breeds as Factors Influencing Beef Carcass Characteristics and Consumer Acceptance (M. B. Badenhop and J. W. Cole, A. H. Dept).

A Study of Rural Community Organizations as They Affect the Diffusion of Information on, and Adoption of, New Farming and Homemaking Techniques (H. J. Bonser).

Economics of Part Time Farming (H. J. Bonser).

Economics of Marketing Milk (M. L. Downen).

The Effect of Price, Price Relationships, Selected Populations, Characteristics, and Income on Fluid Milk Utilization (A Contributing Project to Regional Research Project: SM-10, M. L. Downen).

A Study of Comparative Prices Paid Producers for Milk of Manufacturing Grade in Tennessee and the Midwest (M. L. Downen and Irving Dubov).

Buying Policies and Other Practices of Vegetable Marketing Organizations in Tennessee (A Contributing Project to SM-8, W. E. Goble and E. J. Long).

Relative Cost and Effects of Quality and Market Value of Handcapping and Machine Capping of Strawberries for Processing (E. J. Long, W. E. Goble; and G. A. Shuey, I. E. McCarty, of Gen. Chem. Dept.).

Farm Organization in Type Area (B. H. Luebke, Luther H. Keller).

Impact of Industrial Development upon Tennessee's Agriculture (R. B. Hughes, Jr., J. A. Martin).

Marketing Forest Products (J. A. Martin; and S. L. Barraclough, of Ames Plantation).

An Evaluation of the Use of New Techniques Applied on Test Demonstration Farms in Tennessee (Luther H. Keller, T. J. Whatley).

Labor Requirements and Supply on Tennessee Farms (W. P. Ranney, Luther H. Keller, E. J. Long, T. J. Whatley).

Appraisal of the Effects of Various Factors on the Demand for Poultry and Poultry Products (A Contributing Project to Regional Research Project SM-15, B. D. Raskopf).

Factors Affecting Cotton Prices in Local Markets (A Contributing Project to Regional Research Project SM-1, B. D. Raskopf).

Financial Problems of Farmers' Purchasing Associations in Tennessee (Eldon D. Smith).

Farmers' Financial Problems (R. G. F. Spitze).

Possibilities of Farm Enlargement and Its Influence on Farm Organizations and Returns (T. J. Whatley, S. W. Atkins, Howard J. Bonser).

Farming Adjustments in Tennessee with Emphasis on the Economics of Conservation Farming (T. J. Whatley, S. W. Atkins).

Overall Management and Land Use for the Ames Plantation T. J. Whatley).

Pulliam Tract, Ames Plantation (T. J. Whatley).

Tenant Operations—Ames Plantation (T. J. Whatley).

Marketing Tennessee Horticultural Specialties (A Contributing Project to Regional Research Project SM-12, Norman Zellner, E. J. Long).

Bulletins, Articles and Reports

Badenhop, M. B.

Marketing of Tennessee Lambs Through Cooperative Lamb Pools, 1954. Tenn. Ag. Exp. Sta. Bull. No. 241, April 1955.

Factors Affecting Cattle Auction Market Prices. Tennessee Farm & Home Science, Progress Report No. 15, July, Aug., Sept. 1955.

Marketing Margins, Tennessee Farm Bureau News, Sept. 1955.

Bevins, Robert J.

An Economic Analysis of the Activities of Agricultural Representatives in Tennessee Banks. A Master's Thesis, Dec. 1955.

Butt, Herbert W.

Factors Influencing Group Participation of Farmers and Farm Homemakers with Emphasis on Test Demonstration Fertilizers and Other External Incentives. Master's Thesis, Dec. 1955.

Downen, M. L.

Statistical Data for the Memphis, Tennessee, Milk Market, 1943-1952. Rural Research Series, Monograph No. 270, April 1955.

A Study of the Milk Market of Memphis, Tennessee. Bulletin No. 242, May 1955.

Milk Consumption in Tennessee Schools, March 1954. Rural Research Series, Monograph No. 271, August 1955. (Co-authored with A. J. Garbarino.)

Costs of Processing and Distributing Milk in The South. Southern Cooperative Series Bulletin No. 45, June 1955.

Dubov, Irving

Farmers and the Cost-Price Squeeze. Tenn. Farm Bureau News, Sept. 1955.

Hughes, R. B., Jr.

The Problem of an Adequate Theoretical Framework. Proceedings of Association of Southern Agricultural Workers, Feb. 1955.

Long, Erven J.

Book Review, American Farm Life, Lowry Nelson, Cambridge: Harvard University Press, 1954. PP vii, 192. $3.75. J.F.E., Vol. XXXVII, May 1955.

Rehabilitation of Depressed Rural Areas. Hearings before Subcommittee on Low-Income Families of Joint Congressional Committee on The Economic Report. Low-Income Families, pp 426-436, Government Printing Office, Nov. 1955.

Martin, Joe A.

The Impact of Industrialization Upon Agriculture: A Study of Off-Farm Migration and Agricultural Development in Weakley County, Tennessee. Ph.D. Thesis, University of Minnesota, January 1955.

Ranney, W. P.

Labor Used in Crop Production in Tennessee, 1953—Part IV, Hay, Pasture, and Cover Crops. Farm Economics Circular No. 5, Feb. 1955.

Labor Used in Crop Production in Tennessee, 1953-54—Part V, Crops Harvested for Silage. Farm Economics Circular No. 5, March 1955.

Labor Used in Crop Production in Tennessee, 1953—Part VI, Cash Crops. Farm Economics Circular No. 5, April 1955.

Factors in Saving Farm Labor Costs. Tennessee Farm and Home Science, No. 13, March 1955.

Raskopf, B. D.

Economic Effects of Seed Renewal on Cotton Yield, Turnout, and Staple Length. Tenn. Ag. Exp. Sta., Bull. No. 239, January 1955.

Practicing Progressive Prosperity. Cotton Trade Journal, Feb. 4, 1955.

Directory of Farmers' Cooperatives and Associations in Tennessee. Tenn. Ag. Exp. Sta., Monograph No. 272, Sept. 1955.

Broiler Consumption in Tennessee (Mimeograph), distributed to 233 retail food stores in Tennessee, October, 1955.

Smith, Eldon D.

Urban Employment for Rural People: The Problems and Possibilities of Long Distance Migration. Proceedings of Assn. of Sou. Agric. Workers, Feb. 1955.

Spitze, R. G.

Problems of Economic Power in the Development of Agricultural Policy. Proceedings of Assn. of Southern Agricultural Workers, Feb. 1955.

Whatley, T. J., and Atkins, S. W.

Increasing Incomes through Farm Adjustments in the Grenada-Loring Soil Association Area of Southern West Tennessee. Ag. Exp. Station Bulletin 244, Dec. 1955.

Agricultural Engineering

The Department of Agricultural Engineering this year concentrated on studies in the following projects: equipment and techniques in the production, harvest and storage of grass and legume seeds. Studies were made regarding harvesting, windrowing and air drying.

Investigation in structural and mechanical equipment for storing and handling hay and silage resulted in the development of a device to remove silage from the bottom of an upright silo and a device to distribute silage in a manger built around the silo.

Electric heating panels that may be made at a low cost are under use tests. Construction materials for low-cost farm dwellings have been developed to a point where they are practical for common use, and a two-bedroom concrete house has been constructed. Food machinery for processing agricultural products is under development.

Research Projects

Water Management and Irrigation (A. L. Kennedy).

Paints for Galvanized Roofs (M. A. Sharp).

Materials and Construction Methods for Low Cost Farm Dwellings (M. A. Sharp).

Development of Electric Heating Panels (M. A. Sharp).

Design and Construction of an Effective Mechanical Self-feeding Silo (H. A. Arnold).

Field Sprayer Investigations (H. A. Arnold).

Liquid Fertilizer Distributor (H. A. Arnold).

Distributor for Silage in a Manger Around a Silo (H. A. Arnold).

Investigations in Structural and Mechanical Equipment for Storing, Drying and Handling Hay (H. A. Arnold).

Development of Food Machinery for Processing Agricultural Products (A. H. Morgan).

Equipment and Techniques in the Production, Harvesting, Processing and Storage of Grass and Legume Seeds (C. W. Brown and Erwin K. Boyce).

Curing Air-cured Tobacco (R. B. Stone, U.S.D.A.).

Determination of the Effects of Electro-magnetic Energy on Plants and Animals and Its Possibilities for Control of Insect Pests and Plant Diseases (O. A. Brown, U.S.D.A.).

Construction of an All-Concrete House (M. A. Sharp; and Lorna J. Gassett of H. E. Dept.).

Harvesting and Processing of Grass and Legume Seeds under Southern Conditions (C. W. Brown, and E. K. Boyce).

Bulletins, Articles and Reports

Richards, R. F., and Brown, C. W.
Drying Forage Seed Crops in the Field. Tennessee Farm and Home Science, Progress Report No. 16, October, November, December 1955.

Brown, C. W.
Development of Equipment for Spreading Lime and Fertilizer on Steep Slopes. Master's Thesis, University of Tennessee, August 1955.

Sharp, M. A.
Concrete Block Wall Built with Liquid Mortar. Popular Mechanics, April 1955, United States and South American editions.

Laying Blocks Without Sand Mortar. Popular Science, March 1955.

A New Method of Laying Concrete Blocks. Successful Farming, December 1954.

Agronomy

The Department of Agronomy conducts research on problems relating to field crops and soils. Such studies include the classification, mapping, and productivity evaluation of soils within the state, their proper management and fertilization, the study of the efficiency of various kinds of fertilizers, and the study of better and more efficient methods of crop production including weed control, irrigation, and management. Another important aspect of research is the development of new and better varieties of farm crops and the evaluation of currently available varieties.

Irrigation studies were conducted on Sudangrass, cotton, alfalfa, and tobacco. This work included the characterization of the water-holding and water-yielding capacities of various soils, the determination of the proper time to irrigate, the amount of water to apply at each irrigation, and levels of fertility necessary for efficient production under irrigation.

Fertilization work continued with major field crops in the important agricultural areas of the state. With perennial forage crops an important consideration, in addition to the amount of initial fertilization to be used, is the amount of maintenance fertilization to be applied to maintain the stand, and productivity. Field evaluation of various phosphate fertilizers, including rock phosphate, and new fertilizers produced by T.V.A. was conducted. Work continued on the problem of zinc deficiency and methods of fertilization to correct this deficiency.

Chemical weed control studies included work on the control of weeds in row crops by pre-emergence and post-emergence application of herbicides. In addition, studies continued on the residual effect of herbicides in the soil, as well as eradication of undesirable trees and brush by use of chemicals.

Soil survey and soil classification studies continued in cooperation with the Soil Conservation Service. This work includes the mapping of soils throughout the state, as well as the determination of the relative productivity of certain soils, particularly in Haywood County, for cotton. This work is continuing and will be extended to include other crops and areas.

The excellent crop production season of 1955 permitted

the accumulation of extensive data on the performance of varieties of important farm crops. The variety test work was extended to new areas in the State, including crops which had not been considered previously. The results of data this year, and summaries from previous years, will be published early in 1956. A variety of cotton developed by the U. S. Department of Agriculture, in cooperation with the Tennessee Agricultural Experiment Station, is being considered for release. Outstanding characteristics of this variety include earliness, high lint turn-out and high yield.

Laboratory and greenhouse evaluation of several new fertilizers produced experimentally by T.V.A. was continued under a cooperative agreement. Included in these new materials were calcined leached-zone ore and calcined rock phosphate, several fused potassium calcium phosphates, slag produced from a ferrophosphate reduction, and high alumina nitric phosphates.

Research is continuing on the evaluation and improvement of procedures for analysis of soils and liming materials. Personnel of the department have served as collaborators on several analytic problems of interest to the association of official Agricultural Chemists and the Soil Science Society of America.

Research continued on the fluorine content of soil, vegetation, and animal samples. Survey collections analyzed included rainwater, pond and stream water, samples of feed, pastures, and samples of bones and animal excretions. This work is directed toward determining the extent and severity of fluorine toxicity to plants and animals.

The determination of rates of reaction of various liming materials and their influence on the leaching of nutrients from the soil is being continued. Studies on the influence of insecticides and herbicides on the microbiological activity in the soil were initiated.

Research Projects

Breeding for New and Extended Properties in Cottons in the Southeast (D. M. Simpson and E. N. Duncan, U.S.D.A.).

Improving Breeding Methodology (D. M. Simpson and E. N. Duncan, U.S.D.A.).

Methods for Controlling Seedling Diseases of Cotton (D. M. Simpson and E. N. Duncan, U.S.D.A.).

Corn Improvement (L. M. Josephson (U.S.D.A.), and H. C. Kincer).

Improvement of Cultivated Grasses (J. K. Underwood, and L. N. Skold).

The Relation of Soil Types to the Availability of Nutrients to Crops (L. F. Seatz and W. L. Parks).

Minor Element Availability to Crops as Related to Soil Properties (W. L. Parks, W. E. Black, Eric Winters).

Potassium Fertilization of Farm Crops on Different Soil Series in Tennessee (W. L. Parks).

Crop Response to Time and Rate of Potash Fertilization as Influenced by Soil Fertility Levels (W. L. Parks).

The Comparative Value and Relative Efficiency of Various Phosphate Fertilizers under Different Soil and Cropping Conditions (O. H. Long and W. L. Parks).

Fertilizing, Liming, and Manuring of Farm Crops (O. H. Long and W. L. Parks).

Pasture Fertilization and Forage Quality Studies (O. H. Long, J. K. Underwood, and K. B. Sanders).

Pasture Production Investigations (J. K. Leasure, J. K. Underwood and L. N. Skold).

Chemical Weed Control (J. K. Leasure and R. F. Richards).

Evaluation of the Performance of Varieties of Field Crops (L. N. Skold and R. H. Gibson).

Effects of Sub-soiling on Crop Yields (J. N. Odom).

Evaluation of New Plants (J. K. Underwood, N. I. Hancock, L. N. Skold and B. S. Pickett).

Soil Survey (R. J. McCracken and Eric Winters).

Movement and Persistence of Herbicides in the Soil (R. F. Richards).

Soybean Culture and Improvement (L. N. Skold).

Alfalfa Culture and Improvement (L. N. Skold).

Comparison of Perennial and Winter Annual Grass-Legume Mixtures for Winter Grazing (L. N. Skold).

Influence of Fertilization and Soil Properties on Yield and Composition of Alfalfa (S-14) (W. L. Parks and L. F. Seatz).

Moisture Sorption Characteristics of the Major Soils of Tennessee (W. L. Parks and A. L. Kennedy).

The Effects of Various Management Variables on Orchard Grass, Fescue, Ladino Clover, and Alfalfa (J. K. Leasure and L. N. Skold).

Comparative Liming Effectiveness of Limestone, Dolomite and T.V.A. Slag of Equal Particle Size (W. M. Shaw and B. Robinson).

Lysimeter Experiment on the Comparative Availabilities of Magnesium Incorporated as Magnesium Oxide, Magnesium Sulfate and "Sul-po-mag" in Four Soils (W. H. MacIntire, W. M. Shaw, and A. J. Sterges).

Decomposition of Calcium and Magnesium Carbonates in Soils under Field Conditions, including Leaching Investigations (W. H. MacIntire and W. M. Shaw).

Single and Cumulative Additions of Calcic and Magnesic Materials in Lysimeters (W. H. MacIntire and W. M. Shaw).

The Effects of Certain Atmospheric Effluents upon the Growth and Composition of Plants, and Upon Animal Life, at Locales in East and Central Tennessee (W. H. MacIntire, L. J. Hardin, Mary Hardison, and analysts).

Chemical Studies of New Fertilizer Compounds and Mixtures (W. H. MacIntire, S. H. Winterberg, A. J. Sterges, and L. B. Clements).

Effect of Certain Insecticides and Herbicides upon the Biochemical Activities of the Soil (W. M. Shaw, A. J. Sterges, and B. Robinson).

Conservation of Organic Matter in the Soil as Affected by Degree of Neutralization (W. M. Shaw, A. J. Sterges, and B. Robinson).

Bulletins, Articles and Reports

Black, W. E.

The Evaluation of Urea as a Nitrogen Fertilizer on Wheat. M.S. Thesis, U.T., 1955.

Josephson, L. M.

The Use of Cytoplasmic Male Sterility in the Production of Hybrid Maize Seed. Empire Journal Exp. Agric. 23:1-10. 1955.

Josephson, L. M., Stead, B., and Viljoen, P.

Results of Maize Variety Trials in the Highveld Region, 1953-54. Farming in South Africa. 30:27-31. 1955.

Leasure, J. K.

Some Residual Effects of Herbicide Materials. Proceedings Eighth Annual Meeting of the Southern Weed Conference. 322-325, 1955.

Leasure, J. K., and Skold, L. N.

Corn Is Not Getting Enough Nitrogen. Farm Forum No. 53, p. 18, March 1955.

Long, O. H.

Rock Phosphate or Superphosphate. Tennessee Farm & Home Science, No. 16, Oct., Nov., Dec., p. 4, 1955.

MacIntire, W. H.

Behavior of Incorporations of Potassium and Calcium Fluorides. A 6-Year Lysimeter Study. Ag. & Food Chem. 3:722. 1955.

Report on Soils and Liming Materials. Jour. A.O.A.C. 38: 238-9, 1955.

Resume of Fluoride Research at the Univ. of Tenn. Agr. Exp. Sta., 1920-1954. Jour. A.O.A.C. 38:913-31, 1955.

Parks, W. L.

Response of Field Crops to Supplemental Irrigation in Tennessee. Soil Science Society of Florida, Nov. 1955.

Parks, W. L., Overton, J. R., and Hazlewood, B. P.

Supplemental Irrigation on Sudangrass. Tennessee Farm & Home Science, No. 13, Jan., Feb., March, p. 6, 1955.

Parks, W. L.

Fertilization and Management as Factors in Production Costs. Farm Forum No. 53, p. 6, March 1955.

Rhodes, G. N.

The Evaluation of Certain Treatments for Weed Control in Tobacco Plant Beds. M.S. Thesis, U.T., 1955.

Richards, R. F., and Brown, C. W.

Drying Forage Seed Crops in the Field. Tennessee Farm & Home Science, No. 16, Oct., Nov., and Dec., p. 5, 1955.

Shaw, W. M., and MacIntire, W. H.

Report on Neutralizing Value of Limestone. Determination of Calcium Carbonate Equivalence of Limestone and Dolomite through Potentiometric Tritation to pH 7. Jour. A.O.A.C. 38:240-245, 1955.

Simpson, D. M.

From Seed to Yarn. Tennessee Farm & Home Science, No. 15, July, Aug., Sept., p. 3, 1955.

Simpson, D. M., Landstreet, C. B., and Duncan, E. N.

Effect of Fiber Irregularity on Spinning Performance. Agronomy Journal, 47:9, pp. 425-429, Sept. 1955.

Thorne, D. W., Johnson, P. E., and Seatz, L. F.

Crop Response to Phosphorus in Nitric Phosphates. Journal of Agricultural & Food Chemistry, 3:2, pp. 136-140, Feb. 1955.

Thorne, D. W., and Seatz, L. F.

Agronomic Value and Production of T.V.A. Fertilizers. World Crops, 7:4, pp. 159-162, April 1955.

Winters, E., and Parks, W. L.

Zinc Deficiency of Corn. Tennessee Farm & Home Science, No. 14, April, May, June, p. 6, 1955.

Zinc Deficiency of Corn in Tennessee. Better Crops, 39:9, p. 23, Nov. 1955.

Animal Husbandry-Veterinary Science

The Animal Husbandry-Veterinary Science Department conducts research on problems in and methods of improving breeding, feeding, management, marketing and herd health of beef cattle, swine and sheep. Meat studies are conducted to determine the percentage of lean meat, fat and bone of various grades of carcasses. The carcasses in this study will be used in making studies to determine customer's preference. Projects are aimed at developing methods of increasing the net income of livestock producers of Tennessee and producing a quality product. Major emphasis during the past year has been in some of the following fields:

Methods that producers can use in improving the weight gain of the breeding cattle and maintaining sufficient quality are being studied. A production index for cattle based on rate of gain and conformation and type has been developed. Where the production index has been used as a major tool in selection, the productivity of the herds have increased materially.

Performance testing of bull calves as a method of predicting the future of the calves as sires has been continued.

Studies are under way to determine whether variations denoted in X-day pictures of the lumbar vertebra of young calves can be used to separate the normal animals, dwarf, and those that are clean.

Further studies of the poisoning of cattle pastured primarily on fescue indicate that young cattle and bulls as well as cows are susceptible; spontaneous recovery may occur in cattle not removed from pastures where fescue toxicity had developed in cattle.

Radio-active isotopes are being used to study the calcium and phosphorus requirements of cattle, sheep and swine.

The life span of the red cell of swine using chromium-51 labeled homologous erthrocytes was found to be comparable to that of man while those of cattle and sheep were less than ⅓ of this value.

The effects of whole body irradiation on semen characteristics in bulls are being studied.

In pork carcass investigations, differences between dressing percentages on a within-litter basis among the various shrinkage times was not significant, although dressing percentage tended to decrease with an increase in shrinkage time from 0 to 96 hours.

Comparisons of different types of ewes and different breeds of rams for early lamb production show that the major problem is to develop methods of obtaining a high percentage of lambs raised per ewe in the flock.

Results of feeding 10 mg. of stilbestrol per steer daily show that: (1) under some conditions the feeding of stilbestrol to fattening steers on pasture is not economical; (2) the feeding of stilbestrol to fattening steers in drylot confirms results of previous studies at this and other stations that stilbestrol-fed steers gain at a faster rate and more economically, and that carcass grades are not changed appreciably as compared to control steers; (3) the feeding of stilbestrol to bulls did not affect sperm production during a period of 90 days.

Research Projects

The Effects of Certain Atmospheric Effluents upon the Growth and Composition of Plants, and Upon Animal Life, at Locales in East and Central Tennessee (C. S. Hobbs, R. P. Moorman, G. M. Merriman, et al.).

The Improvement of the Producing Ability of Beef Cattle (C. S. Hobbs, H. J. Smith, C. M. Kincaid, R. P. Moorman, J. W. Cole, J. Hugh Felts, J. A. Odom, J. M. Bird, E. J. Chapman, J. B. McLaren, and Lawson Safley).

The Relationship of Pathology of the Reproductive Tract of Cattle Affected with X-Disease (Hyperkeratosis) and Breeding Efficiency (R. P. Gregory, Jr., and Dennis Sikes).

Carcass Yield Investigations with Pork (J. W. Cole and R. L. Saffle).

Sheep Production for Tennessee. (A) Replacement Ewes for Tennessee Sheep Flocks. (B.. Improvements of the Producing Ability of Sheep (H. J. Smith, E. R. Lidvall, H. R. Duncan, J. W. Cole, J. A. Odom, E. J. Chapman, and J. B. McLaren).

Studies of Endocrine Relationships in Farm Animals. (A) Swine (R. L. Murphree and E. R. Lidvall).

Studies of Endocrine Relationships in Farm Animals. (B) Sheep (R. L. Murphree, O. G. Hall and J. B. McLaren).

Studies of Endocrine Relationships in Farm Animals. (C) Beef Cattle (R. L. Murphree, C. S. Hobbs, R. A. Reynolds, and J. W. Cole).

A Study of the Poisoning of Cattle Pastured on Fescue (G. M. Merriman, M. C. Bell, and R. P. Moorman; Department of Agronomy, J. K. Underwood, Eric Winters, and L. N. Skold; and Middle Tennessee Experiment Station, E. J. Chapman and J. B. McLaren).

The Effects of Radiation on Reproductive Physiology in Farm Animals (R. L. Murphree, N. R. Parish, C. S. Hobbs, and C. M. Kincaid).

Ripening of Beef from Cattle Produced under Different Feeding Methods as Related to Palatability, Tenderness and B.Vitamin Content (Bernadine Meyer and Ruth Buckley, Department of Foods and Inst. Management; J. W. Cole and C. S. Hobbs, Department of Animal Husbandry).

Carcass Value Investigations with Beef (J. W. Cole and C. S. Hobbs).

Type and Breeds as Factors Influencing Beef Carcass Characteristics and Consumer Acceptance (J. W. Cole, C. S. Hobbs, Ira Dyer, C. M. Kincaid, and M. B. Badenhop).

Expanded Study and Evaluation of Diagnostic Measures in Vibrio Fetus Infection of Cattle and Sheep (R. P. Gregory and G. M. Merriman).

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Botany Department

Studies conducted by the Botany Department emphasized the improvement of various field crops, through selection, breeding, etc. Particular emphasis has been given to cotton, oats, barley, wheat, crimson clover, lespedeza, and vetch. Vernalization and colchicine treatment studies continued particularly with winter oats.

Quality of cotton in Tennessee has improved considerably over the past 27 years, primarily because short cottons have not been recommended. In 1928 the average staple length in this state was only $^{30}/_{32}$nds of an inch whereas it is now $^{33.6}/_{32}$nds inches. Strength, another important factor to the spinner, is associated with length in upland varieties. In 1954 average length and strength of 18 varieties at 4 locations were 1.03 inches and 1.56 T$_1$ break as against 1.09 and 1.82 for the same varieties and locations in 1955. Increased strength and other quality factors in cotton are in demand to meet competition of the synthetic fibers.

The oat acreage in Tennessee has increased from 104,000 acres, as average of period 1935-'44, to 480,000 acres in 1954, and average yield per acre has increased from 19.6 bushels to 30.5 bushels. Oats are now seeded for winter pasture only, primarily by dairymen, for winter pasture and grain, for green cut silage, and for grain only. Crown rust and other diseases do not injure oats unless they are seeded early in fall. Recently, winter oat strains resistant to crown rust have been entered in the state tests. Two of them, Tenn. 53-12 and Tenn. 53-24, exceeded the yields of all other varieties in the tests this past year.

The first hooded winter barley was introduced by the Tennessee Experiment Station around 1920. The acreage in barley increased rapidly because harvesting could be done without injury to the hands and face. But hooded barleys never excelled the yield of awned barleys. For the first time, however, hooded strain 50-112-38 exceeded the yields of all the awned varieties in the state tests this year.

Many of the studies concerning wheat have been carried on with the cooperation of the Plant Pathology and Entomology departments. Tennessee, like other states east of the Mississippi River, is in the soft wheat belt. Although the demand for soft wheat flour has decreased considerably, many small mills find a market for it, while other mills blend it with hard wheat flour, or soft wheat with hard wheat. Thus, in the breeding program selections on the soft side will be continued. Around 10,000 head selections from various crosses were seeded in head rows. Wheat is more winter hardy than either oats or barley and November seedings can be made profitable.

Primary factors in the improvement of crimson clover are reduction of "shattering," prolonging the vegetative period, and increasing seed dormancy. To these ends, the chief methods used were radiation, colchicine, and selection among progeny of material gathered from over Tennessee. Some 38,000 seeds were gamma-irradiated in the fall of 1954 and space-planted. Seeds from surviving plants were harvested in 1955, bulked and space-planted; they will be studied carefully for mutations. Second generation colchicine-treated progeny were planted, representing 55 treated plants. Cytological methods were worked out to permit chromosome counts in this material, and "doubled" sectors were found among treated plants.

Aims in lespedeza improvement include increasing root growth and seed yield in the annuals, and increasing palatability in the perennial Sericea. Methods used in 1955 were radiation, colchicine, hybridization, and selection. Dormant seeds of all lespedeza species (Kope, Korean, Sericea) showed essentially the same dose-response to gamma rays.

Primary aims in vetch improvement are to increase erectness of adapted vetches and to increase winter-hardiness of erect types grown in other regions. Methods in use are radiation, colchicine, hybridization, and selection. Dormant seeds were treated with several doses of gamma rays, and seeds from survivors were planted last fall. Mutants will be sought in the spring, among plants from 22,500 treated and 5,250 control seeds. A cooperative vetch observation nursery was planted at the Jackson branch station, but all entries were winter-killed.

Vernalization tests, designed to study the feasibility of commercial-scale chilling of winter oats for spring planting, were continued. Measurements of grain yields in 1955 disclosed highly significant differences due to period of soaking seeds prior to cold storage, but no effect from drying the seeds to as low as 14% moisture before planting. One or two hours of soaking at room temperature produced highest yields which were still considerably below those of a spring variety, Andrew. These figures were 44.9 bushels per acre for Andrew, 22.8 for vernalized Forkedeer, and 8.4 for untreated Forkedeer.

Extensive series of colchicine treatments were made to "double" chromosomes of adapted ryes and barleys to permit crossing.

Research Projects

Production and Improvement of Cotton Varieties Suitable to Tennessee Conditions (N. I. Hancock).

Oat Breeding (N. I. Hancock).

Wheat Breeding (N. I. Hancock).

Breeding and Genetics of Lespedezas (T. S. Osborne).

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Dairy Department

The dairy investigations in 1955 have included numerous phases of management and feeding of dairy cows and calves, studies of breeding and observations on quality of milk and dairy products. This work has been done in the laboratories and dairy herds at Knoxville, and at the station herds at Lewisburg, Spring Hill, and Jackson.

Continued progress has been made toward developing Jersey cows of high milking potential with emphasis on high roughage feeding at Lewisburg and Jackson. A system of making type ratings on cows in this project is also being used to aid in selection or culling on this basis. In addition to bulls in use at the stations a number are being tested by cooperating farmers.

Preliminary observations from comparing rotation grazing with soiling for feeding dairy cows show no marked differences in milk production. Only about two-thirds as much acreage was needed for feeding the herd chopped green forage as for rotation grazing, but the former method required twice as much labor and considerably more machinery time.

Raising dairy calves in individual outdoor pens was as satisfactory as barn pens for Holstein calves, but Jerseys gained faster and had less illness in the barn pens. Calves fed one part of whole milk with three parts of a skimmilk-whey-soyflour milk replacer gained slightly more for the first five weeks than those fed only the milk replacer, but by four months these differences had disappeared. Slaughter observations of calves fed different formula milk replacers indicated that combinations of less than 60% skimmilk or more than 30% whey or soyflour did not produce normal curd formation in the stomach. About half of the two-week-old calves slaughtered had been ruminating, indicating the early adaptation of the calf stomach to coarse feed.

A comparison of milk production of suckled vs. milked identical twins was completed. After removing the calves, it was six weeks before the milk yield of the suckled twins equaled that of their milked mates, and the average loss of milk due to the suckling was about 300 pounds in addition to that required to feed the calf.

Long term experiments in which the effect of thyroxine feeding is determined with identical twin cows have been continued. Cows now in their third lactation show no deleterious effects of thyroxine feeding each year during the last half of the lactation.

Four additional pairs of identical twins have been used to determine the effect of heavy grain feeding of heifers upon milking ability. Those that have freshened confirm the previous observation that such early rapid growth and fattening does not enhance milk production and may be inhibitory to varying degrees in different cows.

It was found that the temperature of diluting bull semen had a significant effect upon its livability at 40° F. and upon its freezability for —110° F. storage. The optimum dilution temperature was 80 to 90° F. Other factors affecting freezability of sperm were the diluter composition and percentage of glycerol used, the rate of cooling, the time delay between glycerolization and freezing, and the varying resistance of sperm from different bulls.

Identification of causative organisms in udder infections in

four different herds showed that *S. agalactiae* were of no importance in three herds, although they caused most of the mastitis infections in the fourth herd. *S. dysgalactiae S. uberis*, and viridans or enterococcus organisms were the major causes of udder infection in herds free of *S. agalactiae*.

Radioactive iodine uptake by the thyroid glands of 8 cows has been measured to determine the effect of season and lactation on thyroid actiivty. The experiments indicated only minor differences in thyroid function due to those factors, but a marked effect of small amounts of iodine in the diet upon thyroid uptake of I^{131} was noted. Experiments with milking cows fed radioactive calcium have shown that cows differ markedly in their calcium metabolism in regard to milk secretion. The existence in the udders of some cows of a large reservoir of relatively inexchangeable calcium which can be used for milk formation is indicated from these experiments.

The enzyme lactase which hydrolyses milk sugar was found to be helpful in controlling the sandiness defect in ice cream. Nearly twice as much lactose hydrolyses was required in high solids ice cream as in normal mixes to prevent sandiness. Full pasteurization procedures which inactivate the enzyme phosphatase were also found to destroy lipase, which is important for maintaining good flavor of milk. Changes in flavor and bacterial counts in raw, pasteurized and reconstituted milk held at normal refrigerator temperatures have been studied. It was found that large populations of psychrophilic bacteria may develop in all types of milk, and that these cause undesirable flavors due to protein and fat-splitting enzymes in milk held more than 4 days. An increase in coliform bacteria also occurred under refrigeration.

Research Projects

The Effect of Supernormal Growth of Dairy Heifers Upon Their Milking Qualities (E. W. Swanson).

Maintaining or Improving Fertility of Dairy Bulls or Their Semen Used for Artificial Insemination (E. W. Swanson).

Elements of a Program to Control Mastitis in Pen-type Barns (B. T. Throop, W. W. Overcast, and E. W. Swanson).

Feeding Thyroidally Active Materials to Dairy Cows (E. W. Swanson, S. A. Hinton, and B. T. Throop).

Radioisotopes in the Investigation of the Physiology of Milk Secretion (F. W. Lengemann and E. W. Swanson).

Importance of the Dry Period and Management of Dairy Cows During the Dry Period (E. W. Swanson and S. A. Hinton).

Raising Dairy Calves—I. A Comparison of Two Methods of Milk Feeding, With and Without Rumen Inoculation, Upon the Growth and Feeding Efficiency of Dairy Calves. II. Comparison of an Extracted-Fat Milk Replacement Fed Unchanged or With 25 Per Cent Whole Milk for Dairy Calves. III. Comparison of Open Outdoor Pens with Indoor Barn Pens for Raising Dairy Calves to Four Months. IV. The Effect of Reconstituting Milk for Calf Feeding at 10, 15, or 20 Per Cent Solids Upon Growth, Feed Intake, and Efficiency (E. W. Swanson, S. A. Hinton, and C. E. Wylie).

The Effect of Veal Production by Leaving the Suckling Calf with Its Dam Upon the Lactation Curve and Milking Economy (E. W. Swanson, C. E. Wylie, and S. A. Hinton).

The Influence of a Previous Lactation Upon the Milk Production of Three-year-old Heifers (E. W. Swanson).

Fresh Green Harvested Forage vs. Concentrated Rotational Grazing (J. B. McLaren, E. J. Chapman, E. W. Swanson, and S. A. Hinton).

The Proteolytic Activity of Bacteria in the Ripening of Pasteurized Milk Cheddar Cheese (W. W. Overcast).

The Influence of Holding Raw Milk at 4°C. Upon the Bacterial Content and the Flavor (W. W. Overcast).

Study of the Factors Responsible for the Normal Development of the Cheddar Cheese Flavor (T. W. Albrecht).

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Study of the Enzymes in the Milk Secreting Tissue of the Mammary Gland as They Are Related to Cheddar Cheese Ripenening (T. W. Albrecht).

Development of Strains of Dairy Cattle Especially Adapted to Southern Conditions (R. H. Lush, B. P. Hazlewood, A. G. Van Horn, W. M. Whitaker, and R. O. Thomas).

The Effect of Early and Delayed Grazing on Milk Production from Legume Mixtures (A. G. Van Horn, W. M. Whitaker, and R. H. Lush).

The Effect of Irrigation on Pastures for Dairy Cattle (A. G. Van Horn, W. M. Whitaker, and R. H. Lush).

Comparative Value of Perennial and Winter Annual Grazing Crops for Cool Weather Grazing by Dairy Cattle (A. G. Van Horn, W. M. Whitaker, and R. H. Lush).

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The Identity and Probable Significance of Some Streptococci Producing Atypical Hotis Reactions. M. S. Thesis, U. of Tenn., 1955.

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Neathery, M. W.

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Entomology

The Department of Entomology conducts research on insects that attack our various crops. These pests are a continuous threat to our farmers, and the chief purpose of research is to study the habits of insects so that different means of control can be used. The different means of control vary widely, the

most common being the use of insecticides. However, there are places where insecticides are not practical. Therefore, other means must be used such as cultural methods, planting dates, resistant varieties, and others. The research work of the Entomologly Department in its eight projects covers a very diverse field.

One of the most interesting projects of the past year was the use of systemic insecticides as seed treatments. A material, now known as thimet, was placed on seed just before planting and insect control was obtained. Field demonstration tests with cotton, using 4% thimet on seed, resulted in considerable increases. In three tests in West Tennessee yield of seed cotton was calculated to have been increased from 188 pounds to 472 pounds per acre as a result of seed treatments. Although the method appears to be good, another year's experiment is thought to be worth while before a general recommendation is made for cotton. Plot tests with Mexican bean beetle showed that the insect could be killed with thimet-treated seed, but practical control does not seem feasible.

The work on the army worm project was started during 1955. Light traps were operated at 8 locations—Shelby, Lawrence, Maury, Robertson, Cumberland, Knox, and Greene Counties—from March 1 to November 9. The traps were for observing the seasonal moth flight of the army worm. Army worm moths were caught from March 16 to November 9 indicating five distinct broods. One of the chief purposes of catching army worm moths is to determine whether light traps can be used to forecast army worm outbreaks. Consequently, it is planned to operate the traps for three or more years. The light traps catch a large variety of insects, and records are being made of the more important species as they also may be predictable from records. Also large numbers of certain species are caught which makes it difficult to find the army worm moths; for example, one week's collection contained 3½ gallons of beetles.

Studies were continued on the insects attacking tobacco, legumes, and nursery plants; however, the small number of pests resulted in non-significant data. Infestation of Hessian fly on wheat occurred at Springfield, thus giving a chance of observing resistance in the various strains of wheat. An infestation did not develop at Knoxville.

Research Projects

Flea Beetles Attacking Sweet Potatoes (S. Marcovitch and W. W. Stanley).

New Insecticides Derived from Coal Tar Products (W. W. Stanley and S. Marcovitch).

A Study of the Life History and Means of Control of Insects That Affect the Growth of Cotton (W. W. Stanley and S. Marcovitch).

Breeding for Improvement in Wheat Varieties to Include Resistance to Disease, Hessian Fly, and Changes in Morphological Character (J. O. Andes, N. I. Hancock, and W. W. Stanley).

Ecology and Control of Tobacco Insects (W. W. Stanley and S. Marcovitch).

A Study of the Life History, Ecology and Control of Army Worms, *Pseudaletia unipuncta* and related species (W. W. Stanley and S. Marcovitch).

A Study of the Insects Attacking Legumes, with Special Reference to Alfalfa and Soybeans (W. W. Stanley and S. Marcovitch).

Control of Wooly Apple Aphis and Other Soil-Inhabiting Pests in Nurseries (W. W. Stanley).

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General Chemistry

Experiments in the preservation of fruits and vegetables by freezing, canning, and dehydrating were conducted during the year. This work was done with the object of improving the edible quality of raw and processed foods, and to aid in the selection of varieties best suited for home use and for commercial processing.

Studies of factors that affect the quality of green beans preserved by freezing were continued. Examination of samples, prepared during 1954, was conducted each two months over a period of 14 months storage in below 0°F. temperature. Data indicate that quality impairment can result from several causes. The major cause of poor quality was found to be underblanching.

Blanching tests on a number of varieties of green beans indicate a small but significant difference in the amount of heat required to blanch varieties. These differences are being correlated with storage studies.

During the 1955 strawberry season, studies were conducted to compare costs and effects of removing caps (calyx) from strawberries by hand, and by machine.

Data obtained in the field show that on the average the price per quart for picking and removing caps is 3 to 4 cents more than picking with caps left on as for the fresh market.

Experiments show that fruit damaged in the process of picking and in removing caps by hand in the field rendered conditions favorable for the rapid growth of mold, rot and development of off-flavors. Furthermore, exposure of harvested berries to bright sunlight and the heat of the day results in a rapid destruction of vitamin C of which the strawberry is a good source. Field capped berries, always more damaged than berries capped by machine at the processing plant, show a greater loss by evaporation, more mold and rot development, greater loss of nutritive value, shorter storage life and resultant

down grading of packed product. Work thus far points to a number of advantages to the farmer, processor, and consumer by careful handling to the processing plant where the caps are removed by machine.

In cooperation with the Department of Horticulture, this department preserved 28 varieties of pears for quality evaluation tests. Six varieties of pears were preserved as sweet pickled and are to be evaluated organoleptically.

Experiments conducted during the year in dehydrating fruits and vegetables have been successful in retaining excellent color and flavor in the dehydrated products.

Dehydration studies were made on horse radish roots and Tennessee-grown onions. These vegetables retain their pungency when dehydrated under controlled conditions. Experiments are being conducted on dehydrated granular horse radish and onion to assess the extent of deterioration, if any, during storage under different conditions of temperature, light, containers, and duration. Grown at the higher altitudes of Tennessee, the horse radish may prove to be a profitable cash crop if marketed as a dehydrated product.

Data were obtained on the flavor and color stability of strawberry and blackberry juice concentrates during storage for periods of up to 6 months at room temperature 73° F. and 45° F., and up to 18 months at below 0° F.

Experiments in dehydrofreezing of apples, beans, and onions were conducted during the year. Broccoli, cauliflower, green beans, sweetcorn, and strawberries were experimentally frozen in considerable quantities during the year.

Tests are being made of the protective quality of various wrapping and packaging materials. Tests thus far indicate that polyethylene-coated papers are entirely satisfactory for meats of various kinds.

The study of the effects of different fertilizers on the protein and mineral content of pasture forage was concluded.

Investigations of the coliform bacteria in strawberries have been continued. Considerable effort is being made to develop a rapid and reliable method for the detection of organisms which indicate pollution and which will reject similar organisms that are common residents of the soil and of the plant.

Studies of the occurrence and of the significance of enterococci in frozen vegetables have been initiated. Contrary to published literature, it is found that the organisms appear to be common in nature, and that they are carried into the product in the processing plant.

The chemical phases of the Burley Tobacco projects at the Tobacco Experiment Station were studied. Almost 1700 samples of tobacco were analyzed for such constituents as dry matter, nicotine, potassium, calcium, magnesium, phosphorus, nitrogen, chlorine, ash and sand. The laboratory is a collaborator with the Agricultural Marketing Service, and the Agricultural Research Service, U.S.D.A., in the tobacco studies.

Research Projects

Preservation of Fruits and Vegetables by Freezing (G. A. Shuey, Ivon E. McCarty).

Home Preservation of Fruits and Vegetables by Dehydration (G. A. Shuey, Ivon E. McCarty).

Factors Affecting the Quality of Strawberry and other Fruit Juices (G. A. Shuey and Ivon E. McCarty).

Factors Affecting Technology, Quality and Consumer Opinions of Colloid-Treated Strawberries Preserved by Freezing (G. A. Shuey, Ivon E. McCarty and Assistants).

Quality of Frozen Green Snap Beans as Affected by Methods of Transportation, Processing, Duration and Temperature of Storage (G. A. Shuey, Ivon E. McCarty, and J. O. Mundt).

Relative Costs and Effects on Quality and Market Value of Hand Capping and Machine Capping of Strawberries for Processing (G. A. Shuey, W. E. Goble, Ivon E. McCarty, and A. H. Morgan).

Nitrogen and Ash Constituents of Cultivated Grasses and Legumes as Influenced by Environmental Factors and Cultural Practices (K. B. Sanders).

Determination of the Presence of Coliform Bacteria on and in Fresh and Frozen Small Fruit, and Study Methods of Elimination (J. O. Mundt, G. A. Shuey, and Ivon E. McCarty).

Bacteriology of Green Beans and Other Frozen Vegetables by Direct Microscopy (J. O. Mundt and G. A. Shuey).

Bulletins, Articles and Reports

Mundt, J. O., and McCarty, Ivon E.

The Direct Microscopic Examination of Bacteria in the Washing of Green Beans. (Manuscript prepared and accepted for publication in Feb. 1956 issue of Food Research).

Shuey, G. A.

Home Freezing of Foods. Tenn. Agr. Exp. Sta. Bul. 215, 1950, reprinted as Agr. Ext. Ser. Publication 345.

Dehydration of Fruits and Vegetables in the Home. Tenn. Agr. Exp. Sta. Bul. 183 revised.

Shuey, G. A., Long, E. J., and Morgan, A. H.

Strawberry Harvesting Methods. Tenn. Farm and Home Science, No. 16, Oct.-Dec. 1955, p. 7.

Home Economics

Child Development and Family Relationships.—Work during the year in child development and family relations was concentrated upon completion of the first objective of an overall research program designed to determine the relationship between certain child-rearing attitudes of Tennessee rural parents and various behaviors of their children. Work directed toward completion of the first objective, construction of parent attitude scales, consisted of the administration and analysis of preliminary sets of items which were given by personal interview to a pre-test sample of 102 mother-father pairs located in rural communities of thirteen counties. The counties were distributed in the three main geographical areas of Tennessee and were selected by the North Carolina Institute of Statistics.

Foods and Institution Management.—The frozen batter and dough project initiated in 1947 by the Foods and Institution Management Department was completed in December, 1955. This project was concerned with developing and improving methods for home freezing of batters and doughs. Fruit pies, shortened cakes, sponge cakes, quick breads, and yeast breads, frozen pre-cooked or in the dough state, were tested during the course of the study. Physical and chemical tests were employed in conjunction with palatability tests to measure changes in product quality after various periods of freezer storage. Based

on the findings of these tests a bulletin entitled "Breads, Cakes and Pastries from the Home Freezer" was prepared for homemakers' use. To date approximately 20,000 copies of this bulletin have been distributed. In addition 7 technical publications have been issued as a result of this study.

A new project concerning the effect of ripening on the palatability and vitamin content of beef was initiated in September, 1955.

Home Management.—Research in Home Management has been focused on two continuing investigations, a new project, and a proposed one.

The study of factors affecting the purchase and use of fruit and vegetable sources of ascorbic acid by rural mountain families has been continued. Drawing of family and food store samples, pretesting and revising schedules, and planning of analytical procedures have been completed. Preparations for field work are in progress.

Study of the relationships between specified body measurements and space used for sitting, rising, reaching, and bending has been continued. Analysis of the correlation between body measurements and reaching is in progress.

A new project, Income and Expenditure Patterns of Tennessee Farm Families, was initiated. The reliability of the data, taken from a state-wide survey conducted in 1950, has been measured by the computation of the standard error of the mean for income and the principal expenditure categories.

A study of procedures for use with washing machines has been proposed. The project will include the effects of varying the concentration of detergent, the water temperature, and the water hardness on the amount of cleaning accomplished. The cost of cleaning under the various conditions studied will be calculated.

The project, Space Requirements in Rural Houses, will be completed when a semi-technical bulletin incorporating the findings is prepared. The study of rural family spending was terminated with the publication of a technical bulletin on methodology.

Nutrition.—Experimental work in nutrition has continued on the regional project, Requirements and Utilization of Selected

Nutrients in Preadolescent Children. Calcium, phosphorus and magnesium are being determined in the food and excreta of the 7- and 8-year-old children who were kept on a controlled, adequate diet for 64 days in the fall of 1954. Other Southern Stations are carrying out analyses for different nutrients in order to find the metabolic pattern of girls of this age. X-ray photographs made on the Louisiana and Tennessee children in this study and on a group of 7- to 9-year-old girls living in an institution have been analyzed and bone indices calculated. Publications giving the results of the 1954 experiment are being prepared and work on plans for another metabolic experiment to be conducted in the summer of 1956 is in progress.

Two papers reporting studies on college students which dealt with the utilization of calcium in restricted diets and interrelationships of calcium with other dietary constituents in these diets have been submitted for publication. The experiments indicated that subjects can be kept in calcium equilibrium on milk-free diets supplemented with dicalcium phosphate but that about one and one-half times the recommended calcium intake is required when the mineral is the principal source. The results also suggested that riboflavin can be utilized at intakes above the recommended level. No changes in bone density of young college women resulted from large differences in calcium intake for relatively short periods of time.

Textiles and Clothing.—The Textiles and Clothing Department has completed all chemical and physical testing of fiber and of new material, control fabrics and household articles and clothing made from two varieties of Tennessee cotton (Delta Pine 15 and Tennessee 241). Statistical analysis of the results obtained is near completion.

Work for 1955 (January-July) on the Consumer Preference Study of Six Selected Clothing Items included the final tabulation and rechecks on the last four items (dresses, hose, shoes and slips). A statistical analysis was made on all of the items. Detailed reports on each test made by the statistician have been filed in the Textiles and Clothing Department, as well as a compiled report of the results.

Research Projects

The Relationship Between Child Rearing Attitudes of Rural

Parents and Selected Behaviors of Their Children (Harold D. Holloway, Mary E. Keister and Ella J. Day).

Freezing Preservation of Precooked and Ready-to-Cook Products in Which Wheat Flours Are Used. (Bernadine Meyer, Ruth Moore and Ruth Buckley). Completed December 1955.

Ripening of Beef from Cattle Produced under Different Feeding Methods as Related to Palatability, Tenderness and B-Vitamin Content (Bernadine Meyer, Ruth Buckley, and Ruth Harris).

Retailing and Family Buying Practices as Related to Purchase of Fruits and Vegetables by Rural Mountain Families. (Phyllis Ilett and Myra L. Bishop).

Space Requirements for Meal Service and Preparation in Southern Rural Homes (Lorna J. Gassett, Myra L. Bishop; M. A. Sharp of Agricultural Engineering cooperating).

Relationships Between Specified Body Measurements and Space Used for Sitting, Rising, Reaching, and Bending (Lorna J. Gassett, Joann Hallaway and Myra L. Bishop).

Rural Spending Ways (Josephine Staab and Myra L. Bishop). Completed June 1955.

Income and Expenditure Patterns of Tennessee Farm Families (Phyllis Ilett and Myra L. Bishop).

The Utilization and Requirements for Calcium, Phosphorus, and Magnesium, and Their Interrelationships with Other Nutrients in Preadolescent Children (F. A. Schofield, E. Morrell, B. B. McDonald, P. S. Richardson, D. E. Williams, and F. L. MacLeod).

Bone Density Measurements as a Method of Assessing Calcium and Phosphorus Status (E. Morrell, B. B. McDonald, P. S. Richardson, F. A. Schofield, D. E. Williams, and F. L. MacLeod).

A Study of Tennessee Cotton: Certain of Its Chemical and Physical Properties Related to Its Ultimate Consumer Serviceability (Ruth L. Galbraith and Ida Adelaide Anders).

Consumer Preference Study of Selected Clothing Items (Helen Thomas and Ida Adelaide Anders). Completed June 1955.

Bulletins, Articles and Reports

Meyer, Bernadine; Moore, Ruth; and Buckley, Ruth

Gas Production and Yeast Roll Quality After Freezer Storage of Fermented and Unfermented Dough. Manuscript in press.

Staab, Josephine

The Effect of Classification on the Coefficient of Income Elasticity of Farm Family Expenditures. Agr. Exp. Sta. Bul. No. 243, 1955.

Schofield, Frances A., Williams, Dorothy E., Morrell, Elise, McDonald, Bonnie B., Brown, Elizabeth, and MacLeod, Florence L.

Utilization of Calcium, Phosphorus, Riboflavin, and Nitrogen on Restricted and Supplemented Diets. Submitted for publication.

Williams, Dorothy E., McDonald, Bonnie B., Morrell, Elise, Schofield, Frances A., and MacLeod, Florence L.

Influence of Mineral Intake on Bone Density in Humans and in Rats. Submitted for publication.

Horticulture

The major projects of the department continue to be breeding projects. Two tomatoes from the West Tennessee Experiment Station have been entered in the Southern Breeding Trials. One of these tomatoes has been lifted to comparative yield tests from the observational test and has received favorable notice from many of the stations using it.

Other breeding projects are in operation with bramble fruits, sweet potatoes, beans, pears and strawberries.

Four new projects were added during the year, one dealing with minor elements and their effects on horticultural crops on the Plateau, and one designed to develop an understanding of the sodium-potassium relationship in plants carried on at the Oak Ridge Laboratory. The minor element project is in cooperation with the Department of Agronomy. Two of these projects deal with florist problems, one to determine the best varieties

of petunias for use under Tennessee conditions, the other to find means of growing snapdragons under glass during the summer months.

Minor element work on the Plateau Station and at Dayton continues to indicate that boron is the most likely to be limiting. Indications are that zinc can be limiting under certain conditions.

The strawberry breeding project has somewhat recovered from the damage due to the severe drought of 1954, but it will be some years before complete recovery will be made.

Irrigation work continued with snap beans at Dandridge and with strawberries at the Plateau. Both crops showed remarkable response in view of the relatively good season.

Research Projects

Breeding for Fire Blight Resistance (B. D. Drain, G. A. Shuey, Lawson Safley, W. E. Roever, and J. O. Andes).

Inheritance in Raspberries (Brooks D. Drain and G. A. Shuey).

Breeding and Selection of Blackberries Including Dewberries (T. H. Jones, G. A. Shuey as cooperator).

Breeding Commercial Strawberries for Tennessee (W. E. Roever, B. D. Drain, B. S. Pickett).

Inheritance in Garden Beans with Reference to Resistance to Mexican Bean Beetle and Other Insects, Nematodes, Diseases, Southern Adaptation and Commercial Quality (A. B. Strand and Horticulture Department).

Sweetpotato Improvement (H. D. Swingle and W. E. Roever).

A Study of the Degree of Substitution of Sodium for Potassium as a Requirement for Plant Growth and of the Essential Role of Potassium (Robert C. Anderson and B. S. Pickett).

Irrigation (B. S. Pickett, A. B. Strand, and A. L. Kennedy).

Propagation Methods (Station Staff).

Varietal Trials (of all kinds) (B. D. Drain, W. E. Roever, Lawson Safley, T. R. Gilmore, H. D. Swingle, G. A. Shuey).

Peach Variety Trials (Troy H. Jones, G. A. Shuey).

Nut Crops (Brooks D. Drain, Knoxville, and others at substations).

Apple Varieties (T. R. Gilmore).

Strawberry Rotation Studies (Troy H. Jones and Branch Station Horticulturists).

Improvement of Nursery Stock (Brooks D. Drain).

Strawberry Fertilization (T. R. Gilmore).

Grape Variety Trials (Troy H. Jones, T. R. Gilmore).

Bean Variety Study (H. D. Swingle, T. R. Gilmore and others).

Cole Crops Variety Test (T. R. Gilmore, H. D. Swingle).

Ornamentals (B. D. Drain, A. C. Koelling).

Bedding Petunia Variety Trials (B. S. Pickett, R. B. Thompson and A. C. Koelling).

Variety Trials of Snapdragon for Summer Bloom Under Glass (B. S. Pickett, A. C. Koelling, R. B. Thompson).

Varietal Trials (Vegetables) (H. D. Swingle).

Breeding of Greenwrap Tomatoes for Tennessee (W. E. Roever and H. D. Swingle).

Strontium Intake by Plants and Animals (R. C. Anderson).

Minor Element Nutrition as Related to Horticultural Production on Tennessee Soils (T. R. Gilmore, B. S. Pickett, and W. L. Parks cooperating).

Bulletins, Articles and Reports

Drain, Brooks D.

Inheritance in Black Raspberry Species. Submitted for publication in the Proceedings of the American Association for Horticultural Science.

A Quarter of a Century of Tennessee Horticulture. Presidential address at Tennessee State Horticultural Society.

Jones, Troy H.

Select Fruit Varieties Best for Tennessee. Tennessee Farmer and Homemaker, p. 12, December 1955.

Pickett, B. S.

Some Lessons from University of Tennessee's Roadside Market. Tennessee State Horticultural Society Annual Proceedings, 1955, p. 27. Progressive Farmer, May 1955. Virginia Horticulture, February 1955.

Soil Fertility in Tennessee Orchards. Presented at Tennessee Horticultural Society Meetings, 1954, p. 54.

Thompson, Roger B.
The Snapdragon, a Florist Crop for Early Summer. Tennessee Farm and Home Science, p. 6, No. 15, 1955.

Physics

SPINNING LABORATORY

The spinning test was refined and standardized at a ½ lb. sample size. Work was started on a process for spinning directly from sliver to eliminate the roving stage. First tests with the spinning frame regeared for high draft and using a special condenser showed that the yarn made by direct spinning would be nearly as strong as normal yarn.

Blending of fiber samples, closer control of fiber analyses and closer control of spinning processes were found to improve correlations in fiber properties with spinning tests. Blends of fiber samples having different properties were found to behave in both fiber and spinning tests in the same manner as homogenous samples having the same average values for fiber properties as did the blends.

The inclined plane tester was further reworked to permit semi-automatic tabulation of single strand breaks at varying gage lengths.

Studies were made cooperatively with the Cotton Processing Section of the Southern Regional Research Laboratories on the drag of rovings at different twists. Using elementary instruments built in the Physics shop, reproducible and comparable twist curves were obtained at both laboratories. Further work is needed in reducing operator differences and in establishing quantitative values.

Research Projects

Development and Organization of Small Scale Spinning Tests (P. R. Ewald, C. B. Landstreet, Herbert Hutchens).

Development of Apparatus and Equipment for Processing Small Quantities of Cotton into Yarns for Testing Purposes (P. R. Ewald, C. B. Landstreet, Herbert Hutchens).

Studies of Relationships Between Fiber Properties and Spinning Processing (P. R. Ewald, C. B. Landstreet, F. L. Morgan).

Development of Instruments for Measuring and Controlling the Strength and Uniformity of Cotton Yarns, Rovings, and Slivers in the Spinning Process (K. L. Hertel, P. R. Ewald, C. B. Landstreet).

Experimental and Theoretical Studies of the Strength and Structure of Cotton Yarns, Rovings and Slivers (K. L. Hertel, P. R. Ewald, C. B. Landstreet).

FIBER RESEARCH LABORATORY

The ability of the Arealometer, or surface fineness meter, to measure the fineness and cross section shape of ramie was investigated. It was concluded that the Arealometer could rank ramie samples in order of fineness, but gave readings which, when converted to weight per inch, were lower than independently measured values. The reduced values were provisionally attributed to the fact that ramie fibers are lacking in natural crimp, a property which allows cotton fibers to be formed into a test plug having the necessary degree of homogeneity.

Some improvements were made in the lint fraction balance, or "Lint Percenter," reported last year. Thirty of the improved models are now being made by an instrument manufacturer.

Some work was done toward the development of improved clamps for use in the Stelometer. It was found that higher reproducibility seems to result from narrowing the clamping surfaces and using thinner, disposable gaskets.

A great deal of work was done, partly under contract with Southern Regional Research Laboratory, investigating correlations between Stelometer elongation readings and all other available fiber, processing and yarn properties for over six hundred cottons from three crop years. Yarn elongation was the only available yarn property clearly correlated with Stelometer elongation. It is hoped that future comparisons can be made between Stelometer readings of elongation and tenacity and some fabric properties associated with the energy required to break fibers, such as abrasion resistance and tear strength.

Occasional inconsistencies between fineness readings given by Speedar and Arealometer are now thought to be chiefly due to exaggerated heterogeneity in some cotton samples. Heterogeneity seems to raise the fineness readings given by straight-

through air flow, as in the Arealometer, or Micronaire, and to lower readings given by the type of flow pattern used in the Speedar. Considerable work has been done toward developing a flow pattern in the Speedar which is not affected by heterogeneity. This work is still in progress.

Research Projects

Rapid Methods for Measuring Length and Other Properties of Cotton Fibers (K. L. Hertel, C. J. Craven, Reba Lawson, Ray Mink, and Sherman Breeden).

Development of New and Improvement of Existing Instruments and Techniques for Measuring Properties of Cotton (K. L. Hertel, C. J. Craven, Reba Lawson, Ray Mink, and Sherman Breeden).

Theory of Textile Fabrics (K. L. Hertel, C. J. Craven).

Bulletins, Articles and Reports

Hertel, K. L., and Craven, C. J.

Speedar Measurement of Fiber Fineness and Compressibility. Textile Research Journal XXV, No. 5, May 1955; and translated in Textil Praxis, September 1955.

Plant Pathology

The control of plant diseases being of basic concern to agriculture necessitates a continuing study. While major effort is usually directed towards the solution of specific problems embodied in designated projects, there are overall considerations that must be taken into account. Such general activities included during the past year the identification of several hundred plant disease specimens requiring technical diagnosis; preparation of spray schedules; and general assistance for the Extension Service and individuals.

The occurrence of Dutch elm disease on the University campus necessitated considerable work in laboratory diagnosis of specimens and planning a control program. Losses due to plant diseases in the State are of direct interest to several agencies, hence the pathologist as a collaborator of the U. S. Department of Agriculture, Plant Disease Survey, compiles and

verifies these as estimates. In this manner a general understanding of the trends in plant diseases within the State is possible and early remedial measures can be taken.

Among the conspicuous troubles occurring during the past year may be noted increasing consciousness of nematode damage to a wide range of plants, virus diseases of beans, tree diseases, club root of cabbage, and an increasing build-up of leaf-spotting diseases in the commercial production of greens for processing.

Collaboration with the state regulatory offices and strawberry plant producers resulted in indexing foundation strawberry stock enabling this industry not only to supply local growers but to build up a successful business. If high standards can be maintained it appears that this may continue to develop and increase the state agricultural income with a non-restrictive crop. Better methods of determining masked virus complexes is one of the objectives of this study and it appears that a practical working procedure is now available.

Progress was made on most of the projects during the past year which was reasonably favorable for field experiments. The spring freeze destroyed the fruit crop and eliminated planned fungicide tests, but ample opportunity was afforded to utilize some of the newer materials on certain vegetable diseases. The need for further investigation in seeking more effective fungicides for turnip green leafspot control was demonstrated and experiments were set in motion to provide same. A screening program utilizing some new chemicals in this preliminary manner have been shown as effective fungicides for about 10 common local plant pathogens. Approximately 50 materials have been tested during the past year.

Under another project practical methods of nematode control were studied. A number of commercial fumigants were used to evaluate carriers of the nematocidal chemical, utility, means of application, soil preparation, and effectiveness. The results in sandy soil were conspicuously good at a rate of 20 gallons per acre, of 85% EDB, but below that the kill was not satisfactory. The expense of this operation and the fact that in clay soils poor control was obtained makes the widespread employment of soil fumigation questionable until more positive results can be predicted. At the same time in special situations

the use of soil fumigation may be quite profitable. Further examination of specimens showed the wide occurrence of these plant pests in the state and has revealed the extensive damages not heretofore recognized. These are being recorded as a part of a state-wide plan to determine the prevalence and extent of damage due to nematodes in order to devise practical, economical, and effective recommendations.

In seeking a biological means of preventing root- and soil-borne diseases of plants a fundamental approach is being made utilizing antagonistic reactions among microorganisms inhabiting the soil. Considerable promise is indicated by the studies that some of the complex plant disease situations in soils may be resolved in this manner. Preliminary work with this project on corn showed marked variability in susceptibility among varieties to *Pythium arrhenomones* root rot. Red clover resistant to southern anthracnose was found long ago to have a great deal of variability and during the past summer the local planting suffered severely when inoculated with the organism. A few plants, however, proved to be highly resistant and progeny are being increased for the high type resistance of the original line. Some incidentally, have very good agronomic characters.

Strawberry root rot studies followed much the same pattern as heretofore, seeking new sources of resistant material for breeding as well as testing those on hand with their hybrids, for resistance to the pathogens. Tomato fruit rot investigations consisted essentially of screening the older lines for resistance primarily to buckeye rot and late blight, and breeding for resistance to other rots and nematodes. Several new hybrids incorporating specific resistances as well as quality were developed this season and backcrossing for further improvement has already been made. In the course of the investigations a new tomato anthracnose was found.

Barley scald control by seed treatment has been confirmed by laboratory, and field scale experiments were put out in the fall. Association of fungi within the roots of normally appearing cereals suggests that such relationships are not necessarily detrimenetal but on the other hand may be beneficial. Cereal root rot investigations were continued by cataloging the nematodes associated with cereal roots. This included Protylenchus, Ditylenchus, Moloidogyne, and Rotylenchus as the most con-

spicuous genera obtained. While considerable significance is attached to the discovery of root-knot nematode injury to barley, the usual presence of the meadow nematode in barley specimens examined from all parts of the state lends a more serious aspect. Selections are sought for resistance to *Helminthosporium sativum* in barley among progenies of irradiated seed, and new techniques for screening resistant lines are being developed.

Research Projects

New Fungicides and Their Relative Efficiency and Practicability as Compared with the Fungicides Commonly Employed at Present (J. O. Andes, James M. Epps, and E. S. Brown).

Breeding for Improvement in Wheat Varieties to Include Resistance to Disease, Hessian Fly and Changes in Morphological Characters (J. O. Andes, N. I. Hancock, and W. W. Stanley).

The Development of Tomato Varieties Resistant to Fruit Rots (E. L. Felix).

Strawberry Root Rots and Their Control (E. L. Felix).

Breeding Disease-Resistant Tobaccos (D. H. Latham).

Control of Cotton Verticillium Wilt (James M. Epps).

Root Diseases of Small Cereals (H. E. Reed).

Barley Scald and Its Control in Tennessee (H. E. Reed).

Alfalfa Crown Rot Control (J. O. Andes and E. S. Brown).

Breeding Disease-Resistant Red Clover (James M. Epps and J. O. Andes).

Nematode Control by Fumigants (James M. Epps and J. O.

Soil Microbiology (J. O. Andes and L. F. Johnson).

Identification and Control of Strawberry Virus Diseases (J. O. Andes).

Bulletins, Articles and Reports

Andes, J. O.

Plant Disease Loss Estimates in 1954 for Tennessee. Plant Disease Reporter, 39:280-282, 1955.

Streptomycin and Tobacco Wildfire Control. Tennessee Farm & Home Science, 16: 6, 9, 1955.

Committee (Entomology, Horticulture, and Plant Pathology Departments).

Fruit Pest Control Schedules. Agr. Ext. Ser. Sp. Cir. 438 (rev.), 1955.

Felix, E. L.

Black Root of Strawberry Seedlings Grown Aseptically (Abst.). Phytopath. 46:11, 1956.

Some Tree Diseases in Tennessee. Plant Disease Reporter, 39:882, 1955.

Johnson, L. F.

Plant Disease Control with Soil Microbes. Tennessee Farm and Home Science, 13: 4, 10, 1955.

Studies on Root Rot Control by Microorganisms Antagonistic to *Pythium arrhenomanes* (Abst.). Phytopath. 46:16, 1956. 1956.

Mullett, R. P., Stanley, W. W., Andes, J. O., and Leasure, J. K.

Recommended Insecticides, Fungicides, and Herbicides. Agr. Ext. Ser. Sp. Cir. (rev.) 394, 1955.

Reed, H. E.

Occurrence of Dutch Elm Disease in Tennessee. Plant Disease Reporter, 39:382, 1955.

Studies on Barley Scald and Its Control in Tennessee (Abst.). Phytopath. 45:350, 1955.

Poultry

The Poultry Department during 1955 included in its investigations work dealing with poultry nutrition, breeding, management, control of parasites and the processing of poultry and poultry products. New structures on the farm include a 32 x 160 foot laying house, a 40 x 100 foot brooder house and a 32 x 60 foot brooder house.

A Random Sample Laying Test, the first initiated in this geographical area, has been approved. This project will evaluate the egg production performance as well as the economy of production of pure bred, cross bred, incross, incross bred, and strain crosses of chickens available to Tennessee poultrymen.

F_2 males and females (from White Laced Red Cornish males crossed to Single Comb White Leghorn females) have been tested for homozygosity of the dominant white gene and for the presence of the sex-linked gene for rapid feathering. Selected individuals will be mated together in a continuation of the project to develop a desirable broiler stock.

In breeding and the testing of lines of White Rocks and New Hampshire chickens has continued with the objectives of developing inbred lines that will transmit a high or low degree of resistance to cecal coccidiosis to their progeny when used in top-crosses with other stock.

The study dealing with high and low energy diets for laying hens has been expanded. Single Comb White Leghorns, New Hampshires, and White Rocks have been utilized in the study. Hens fed the all mash ration containing 903 calories per pound of feed gave higher production than did the hens receiving an all mash ration containing 712 calories per pound. The high energy feed required fewer pounds of feed to produce a dozen eggs than did the low energy ration. Each ration contained 17% protein.

Hydrolyzed feather meal was found to be a satisfactory protein concentrate for laying hens when used at the 2½ and 5% level. Chicken by-products meal was equal to high quality meat scraps when used either in a laying ration or for the production of broilers. These two products are relatively new protein concentrates and like other protein rich feeds are satisfactory to use as feed ingredients provided their amino acid deficiencies are recognized and properly supplemented.

During the year several grades of corn were incorporated in broiler rations to evaluate their feeding value. These studies are underway and progress reports are expected to be released in 1956.

Investigations regarding the effects of restricting feed intake of growing pullets has continued. Single Comb White Plymouth Rock hens which completed their production year during the summer of 1955 produced approximately the same number of eggs per hen while in the laying house, regardless of the feeding method used while they were on range. During the growing period the 4 lots of pullets received feed free choice or

90, 80, or 70 percent of full feed. The data secured are in agreement with previous reports.

During the winter of 1955, meat type, New Hampshire pullets were grown to 11 weeks of age in confinement. When 11 weeks of age, March 15, 1955, the pullets were placed on slat floors enclosed with wire and partially covered to give some protection from the weather. Two lots received a ration containing 21% protein, while two other lots received a ration containing 17% protein. Paired lots were restricted to 85% of full feed, while the other pair received feed ad lib. These meat type birds failed to respond in increased production when grown on full feed throughout the entire period or when the plan of nutrition was increased, when the pullets were mature. Better protection from the elements, as well as over-all better growing conditions and adequate pasture are indicated if a restricted feeding program is followed.

Single Comb White Leghorn pullets fed two coccidiostats, polystat and sulfaquinoxaline (0.0176%), and inoculated with laboratory cultures of *Eimeria tenella* showed little difference in age at sexual maturity, egg size, or total egg production throughout their first year in the laying house. The information secured confirms similar tests reported in 1954 in which sulfaquinoxaline and nitrofurazone were used.

The use of the antibiotics; bacitracin, streptomycin, aureomycin, and neomycin fed orally failed to show protective value against the production of *Salmonella pullorum* reactors. Variation of weight gains in these groups was insignificant when compared with control groups. A group of inoculated birds which later gave negative reactions to the whole blood rapid plate test for pullorum, were inoculated with *Salmonella oranienburg*, subsequently the birds gave positive reactions. This organism apparently reactivated the static pullorum organism which again produced an active infection as evidenced by antibodies. Birds inoculated at two days of age with *Salmonella pullorum* had a high initial percentage of reactors (50-55%) which fell to 2% at four months at which level they remained until sexual maturity when the percentage of pullorum reactors increased to 20%. The use of aureomycin at the 250 and 100 gm/ton levels had no effect on the egg production of the carriers in the latter groups when compared with an inoculated control.

Two groups of Single Comb White Leghorn cockerels were placed on range known to be contaminated with nematode eggs. Group A was not treated while each bird in Group B was wormed each month with a combination nicotine-phenothiazine pellet. Results showed that as many worms were recovered in Group B as in Group A; however, those recovered from Group B contained a higher percentage of larval forms. A consistent slight weight differential in favor of Group B was noted; however, the difference was insignificant.

In the field of poultry products it was found that eviscerated broilers absorbed water to the extent of 15% of their body weight when immersed in tap water for a period of six hours. Dressed hens and cocks absorbed 3 to 5% moisture when cooled in tap water. From two to four hours was required to reduce the carcass temperature of broilers, fowl, and capon when placed in ice slush and crushed ice. Agitated and non-agitated iced mediums were more effective in hastening the rate of cooling dressed and eviscerated broilers, fryers, hens and cocks than was circulated air, still air, or tap water.

Tests are under way to evaluate the cooking quality and flavor as well as bacterial population and shelf life of poultry cooled in tap water, ice slush, or in a forced draft chilling room, and at room temperature.

Research Projects

Vegetable Protein Investigations with Chicks (R. H. Harms and O. E. Goff).

Improving the Body Conformation of Broiler Chickens (H. V. Shirley, Jr., and O. E. Goff).

Influence of Wraps on Shelf Life of Chilled and Frozen Poultry (J. O. Mundt and F. R. Tarver, Jr.)

Comparative Feeding Value of Different Grades of Yellow Corn for Broilers (R. H. Harms and O. E. Goff).

Drugs in the Control of Internal Parasites (R. L. Tugwell).

Pastures for Chickens with Particular Reference to Parasitism (B. J. McSpadden and R. L. Tugwell).

Relationship Between Body Conformation and Meat Yield (O. E. Goff, F. R. Tarver, Jr., and G. C. McGhee).

High Efficiency Rations for Poultry (R. H. Harms, G. C. McGhee, and O. E. Goff).

Influence of Environment on Performance of Hens (H. V. Shirley, Jr., O. E. Goff, and L. H. Littlefield).

Evaluation of Antibiotics in the Control of Salmonellosis in Poultry (R. L. Tugwell, J. O. Mundt, and O. E. Goff).

Influence of Rate of Cooling and Water Absorption on Shelf Life, Cooking Quality and Flavor of Chicken (O. E. Goff, F. R. Tarver, Jr., Bernardine Meyer, Ruth Buckley, and J. O. Mundt).

Improving Chickens Through Breeding (H. V. Shirley, Jr., R. L. Tugwell, O. E. Goff).

Evaluation of Egg Production Stock (H. V. Shirley, Jr., and O. E. Goff).

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Shirley, H. V., Jr., Tugwell, R. L., Goff, O. E.

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Ames Plantation

Fayette and Hardeman Counties

A pilot farm or demonstration farm was put into operation on a 310-acre tract of land on the Ames Plantation in 1955. Alternative systems of farming were developed for this tract in 1954 and the Ames Foundation made available $50,000 in the form of a loan to start this farm. A cotton-beef-hog-forestry system has been established. During 1955 building improve-

ments were made on this tract and approximately 70 acres of improved pasture was established. Ten brood sows were purchased in the fall of 1955 and around 20 brood sows will be added in 1956.

The actual income and expenses on this pilot farm in 1955 were very close to the estimated income and expenses. It is anticipated that the long-range proposed plan of operation will be fully developed by 1958.

Numerous visits were made to this farm by local farmers in 1955. Approximately 100 people visited it on a Field Day in November.

An over-all plan for the Central Unit, Ames Plantation, was started in 1954 and put into effect in late 1955. As a part of this operation the following phases should contribute toward improving agriculture in the cotton section.

1. Certified cotton seed are being produced to increase the quantity of good seed available for planting.
2. Production testing has been started on the large beef herd on the Plantation. Some of the better animals from this test will be made available to farmers in the area for breeding purposes.
3. Production testing on the swine herd is being carried on similarly to work with beef cattle.

The project on tenant operations on the Plantation was prepared in the fall of 1955 for the purpose of increasing production on tenant units, and to work out tenure arrangements for dividing this increased production between tenants and the Plantation. Too, this project offers an opportunity to study best methods of financing these adjustments on tenant units. The actual operations under this project are getting under way.

Forestry Program

During 1955 two stumpage sales were made of about 200,000 board feet each, and 473,000 board feet of mature red cedar have been cut by the plantation's woods crew and sold as logs. In addition to stumpage sales, about 400,000 board feet of hardwood logs will be cut by the woods crew for use in the Ames Plantation sawmill. Special sales of mature hickory and other specialty products may be made whenever justified by market conditions.

The harvest of mature timber will be made so as to improve the growth and composition of remaining stands insofar as possible by removing over-mature and low value trees. Over 500 acres of woodland should be improved by this kind of selective cutting during 1956.

This year weed trees have been girdled from about 200 acres of pine plantation and cull trees were killed on 50 acres of hardwoods. Thinnings and selective cuttings covered some 500 acres.

During the coming year about 300 acres will be planted with pine seedlings. Only land indicated for permanent forest by the land-use plan will be planted. Besides planting 300,000 pine seedlings (100,000 shortleaf and 200,000 loblolly) we will plant a total of about 50,000 cedar, poplar, cottonwoods and oak seedlings.

In 1955 there were planted 100,000 pine seedlings, 5,000 yellow poplar, 2,000 cottonwoods, and 1,000 red cedar at an average cost of $12.00 per acre.

During the year a detailed land-use plan for the Ames Plantation Central Unit was prepared in cooperation with the committee on overall planning. This plan was approved and the woods crew has been clearing merchantable timber from forest areas indicated for other uses.

There was one serious woods fire in 1955 which damaged about 270 acres of timber on the Patterson tract. The fire was suppressed by the forestry crew with the aid of State Forestry Department men and equipment.

The forester worked closely with the Pulliam Farm Committee preparing plans for the demonstration farm. Forest operations have been incorporated as an integral part of the farm plan.

Input-output and financial records have been kept for all forestry operations. Considerable progress has been made in establishing a permanent set of forestry records for the plantation and completing this should be a major goal for 1956. Preliminary plans have been made for a study of forest soils and forest growth on the plantation.

Because the Ames Plantation has long been noted for the National Bird Dog Field Trials it appears desirable to begin a

research project in the field of wildlife-woodland management with emphasis on management for quail. The facilities on the plantation are ideal for such a study and there are excellent opportunities for cooperation with State and Federal wildlife specialists, sportsmen's groups and the like.

One Forestry Field Day was held in 1955, attended by about 30 foresters.

Dairy Experiment Station

Lewisburg

The work at this station which is conducted cooperatively with the Dairy Husbandry Research Branch of the U.S.D.A., is concerned with the breeding, feeding, and management of dairy cattle.

The dairy herd at the end of the year included 104 cows, 33 heifers bred or of breeding age, 68 heifers under breeding age, one proved bull, and 11 young bulls in line for proof. Five of the young bulls have daughters in milk and four others have been mated to a sufficient number of females to furnish reasonable assurance of 10 to 12 daughters of each bull. These animals are available for the cattle breeding project, the object of which is to breed Jersey cattle approaching homozygosity for the factors determining high milk production and for various feeding and grazing studies.

A project was initiated during the year to compare forage (pasture, hay, and silage) production without irrigation with forage production with irrigation. Two paired groups of cows will be used in this project. One group will receive all of the pasture, hay, and silage they consume on a year around basis from a given acreage of unirrigated land. Likewise, the other group of cows will receive all of their pasture, hay, and silage from land which will be irrigated during dry periods.

Studies have also been initiated to compare the feeding and nutritive values of grass silage when wilted before ensiling with the same silage when cut direct with mower bar attachment on a forage harvester. Sodium meta-bisulfide is used as an amendment with the direct cut silage.

An earthen dam with concrete spillway was constructed on

a small stream to impound water for irrigation. It is estimated that about 25 acre feet of water is impounded. A 12-inch cast iron pipe line was placed under the dam so that water can be released as needed and impounded behind low (24-inch) concrete dams located at different points downstream where it can be pumped into a sprinkler irrigation system. There has been some loss of water by seepage through limestone rock formations which are beyond one end of the earthen dam. When the water level was lowered until the lake was nearly empty several sink holes were found. Plugging these sink holes with soil materially reduced the seepage.

The relocation and grading of a new roadway which extends through the station property is a considerable asset to the property. The relocation of the road made necessary the rearranging of some of the fields and the construction of new fences along the roadway and between some of the fields. The new roadway, with a new bridge across the creek, was a badly needed and much appreciated asset to the community in general. This improvement was made by the Tennessee Highway Department.

An additional 135 acres of land adjoining the old station on the north was purchased late in the year. This newly purchased land is nearer the main building site and center of activities than some of the land in the original station property and will be a very useful addition. Some of the purchased land was in a neglected condition and work removing unwanted trees and bushes and fencing of fields is in progress. The new addition of land brings the total acreage in the station to approximately 615 acres, about 465 acres of which is open land.

Forestry Experiment Station

Morgan, Scott and Hamilton Counties

An active forest management program is being carried out on Little Brushy Mountain where 1,600 acres of timber was sold to a local sawmill operator. This first step calls for the removal of all mature and defective trees and the treating of all cull trees by girdling and spraying with 245T. Records are being

kept of all logging and milling time, all products sold, and the grade of each as well as the square feet of basal area girdled and the time required for this operation.

In a study of forest tree species adapted to the Cumberland mountain area of Tennessee tree plantings were replanted to some extent except slash pine, cypress and red gum. The poorest planting was red pine, which was replanted to this species once, then to shortleaf pine. White pine showed the next poorest survival but after one replanting is doing quite well. A new four-acre planting was established this year, consisting of alternate rows of shortleaf pine and yellow popular. An interplanting of 2,000 white pine was made in the logging area where large openings were left.

A loblolly pine, shortleaf pine seed source test was established. Loblolly pine is being tested from the following seed sources: North Carolina Piedmont, South Carolina, Georgia, Arkansas, Virginia, North Carolina Coastal Plain. The following shortleaf pine is being tested: Tennessee, Oklahoma, Virginia, and Georgia.

All hardwoods on the eight plots have been girdled and treated with ammate in order to remove this competition from the pine.

Twelve plots have been laid out and the corner posts set in the pine regeneration study. Due to a very poor seed year no additional work was done on this project.

The station property had no fires in Morgan and Scott Counties. There were two fires on the Friendship Forest in Hamilton County which burned over approximately four or five acres. Both of these fires were at the south end of the property which is used by fishermen and picnic groups during the spring and summer.

No additional experimental fence post treating was done this year. Our annual fence post inspection was made and a summary of the data compiled. An article on fence post treating was written for the Tennessee Farm and Home Science.

Highland Rim Experiment Station

Springfield

Unusual weather conditions affected research at this station in 1955. Rainfall was approximately two inches below the average for the 1944-1954 period. There was an abundance of rainfall until June. The summer dry period caused some damage to most crops. Temperatures of 13° and 15° were recorded on March 26 and March 27, respectively. This late freeze following the warm, moist days of early March, caused considerable damage to early maturing small grain varieties. The fruit crop was a total loss as a result of this freeze.

Improvements of physical facilities at the station this year include the construction of two employee residences; extension of the natural gas system 2,157 feet to include service to three houses; conversion from coal to gas heating systems in four houses and the laboratory building; repairing floors and walls and installing closets in two houses; redecorating two houses, and drilling well No. 8 to furnish water for one house and to supplement the water supply to the livestock barn.

The registered Hereford breeding herd now numbers 42 head of cows and heifers. These animals are used as a unit of the Improvement of the Producing Ability of Beef Cattle project.

The third year of work was completed with the joint Animal Husbandry-Agronomy pasture project in which the following treatments are being evaluated: Orchardgrass and Ladino clover; orchardgrass, tall fescue, and Ladino clover; tall fescue and Ladino clover; tall fescue and Ladino clover with five 50-pound applications of ammonium nitrate at intervals during the growing season.

Uniform variety tests were conducted with corn, oats, barley, wheat, and grain sorghum. The work with the soft winter wheat nursery and with the strains of wheat resistant to Hessian fly were continued. A variety test with varying rates of nitrogen fertilizer, designed to study the results, if any, of the varieties and rates of nitrogen on lespedeza as a companion crop, was started. The following fertilizer tests were continued: the agronomic phase of the joint Animal Husbandry-Agronomy pasture test; phosphate comparison and fertilizer topdressing on

alfalfa; potassium-phosphate factorial experiment on alfalfa; and rate of phosphate, potash study in a three year rotation of corn, wheat, and red clover. A Sorgo variety test with 9 entries was initiated this year in cooperation with the U.S.D.A. Sugar Crops Field Station.

The horticultural work was carried on as outlined in the Horticulture Department report.

Work with tobacco at this station was done on the three types that normally are grown on the Highland Rim; dark fire-cured, dark air-cured, and light air-cured or burley. Major emphasis was on the dark fire-cured or type 22 tobacco.

The work with dark fire-cured (Type 22) tobacco was continued along two general lines. One was breeding and selection for resistance to several diseases, the other from a cultural or management approach. The breeding work was a continuation of the effort to find disease-resistant lines that will be commercially acceptable both to the growers and to the tobacco industry.

Since black shank is not yet on the station, the work with black shank was continued on leased land. Eighty new and previously untested F^3 lines were planted on the black shank field. It is believed that an adequate check on the resistance to black shank in the new lines was not obtained, due to the lack of soil moisture.

The work with mosaic and mosaic-wildfire resistant lines was essentially a duplication of the work in 1954, in which results with two of the mosaic-wildfire resistant lines were encouraging. However, in 1955 it was found that both of these lines were not as resistant to mosaic and wildfire as previously considered. More than 100 lines carrying at least slight resistance to both mosaic and wildfire were grown in the observation plots this year.

Results from a replicated test in which several formulations of streptomycin sulfate were used at 3 concentrations as a control for wildfire on dark fire-cured tobacco did not substantiate published reports of the control of wildfire with these materials on other types of tobacco grown under different conditions. The streptomycin treatments were perhaps more effective than the copper treatments but they neither prevented nor eradicated wildfire under the conditions of 1955 tests.

The source of potash test on dark fire-cured tobacco was continued. This year for the first time, potash deficiency symptoms were evident on the growing plants in the no-potash plots. At the heavy rate of potash a pronounced difference is evident in the cured tobacco from the plots that received the muriate and sulfate forms of potash. The difference appears in favor of the sulfate of potash.

A fertilizer test on dark fire-cured tobacco, in which 18 treatments or analyses were used was set up in 1955. This test uses 5 levels of N, 3 levels of P_2O_5, and 4 levels of K_2O. In addition, one treatment has a trace element mixture added and another one has manure added at rate of 10 tons per acre.

An irrigation and rate of nitrogen test with dark fire-cured tobacco was carried out cooperatively with the Department of Agronomy. Two levels of moisture, other than that from natural rainfall, and 3 levels of nitrogen were used in the test.

The project on the curing of dark fired tobacco, cooperative with the U.S.D.A., that has been in progress since 1950 was discontinued in 1955 because it had become apparent that the tobacco could not be "finished" satisfactorily by that curing procedure.

Little definite information was obtained in 1954, the first year, in the chemical approach to the problem of finding out what takes place during the curing of dark fire-cured tobacco. This test is cooperative with one of the tobacco companies using dark fire-cured tobacco.

The field performance of maleic hydrazide for the control of suckers on dark tobacco in 1955 was unsatisfactory. Not only did the chemical fail to give adequate control of the sucker development but it also caused some very undesirable effects on the plants.

In a three-year test with 5 varieties of One Sucker tobacco, Virginia Improved One Sucker has given an average acre value approximately $80.00 above the other varieties.

Burley yields and values at this station were approximately 25% higher in 1955 than in 1954. B54-417, a burley line related to Burley 1, selected at this station several years ago, had an average acre value of approximately $70.00 above any of the named varieties of burley included in either of the two burley variety tests here this year.

Middle Tennessee Experiment Station

Columbia

Records at the Middle Tennessee Experiment Station in 1955 show precipitation to be near normal, but as in the past four years the distribution of rainfall was the main factor in causing 1955 to be the fourth consecutive drouth year. Such conditions during the last four years caused a decided change in feed production plans at this station. More emphasis is now being placed on the production of both grass and row crop silage. In 1955 approximately 1,200 tons of silage was produced from pasture, alfalfa, sudan grass, corn and sorghum. Two trench silos have been constructed, one in 1954 and one in 1955, with a total capacity of 700 tons.

The 54th annual meeting of the Middle Tennessee Farmers and Homemakers Institute was held at the Middle Tennessee Experiment Station on Thursday, July 21, 1955. Staff members from the various departments at Knoxville were on hand to discuss the research work. The meeting was attended by some 2,500 farm people. The following day the 25th Annual Negro Institute met on the station with approximately 500 present.

Many other groups visited the station during the year, such as the County Farm Bureau Presidents, Soil Conservation Service Personnel, F.F.A. Judging Teams, and representatives of many Community Clubs. These meetings provide an effective means of disseminating information on research at this station.

The agronomic research work at this station was greatly expanded in 1955. Work was initiated on the newly acquired property to determine the production capacity of phosphate land prior to mining. This work includes fertilization experiments with corn, wheat, barley, oats, alfalfa, pasture, rye and crimson clover, sudan grass and lespedeza.

This expanded program also includes irrigation experiments designed to evaluate response to variable moisture and fertility levels on such crops as pasture, alfalfa, and tobacco.

An experiment was initiated in 1955 to determine the economy and efficiency of soiling in relation to concentrated rotational grazing for dairy cattle for milk production. This experiment was conducted on alfalfa in the spring and on sudan grass in the summer.

A bulk milk tank of 485 gallons capacity was installed for the purpose of studying the merits of this new way of cooling milk.

The purebred herd of Hereford cows was carefully culled during the year with the idea of removing the old or the unprofitable cows. For various reasons 17 cows were removed from the herd.

A joint project between the Agronomy and Animal Husbandry Departments was initiated in the fall of 1955, to study the value of different rates of nitrogen on permanent pastures for beef production. The test contains 12 plots of 3 acres each and will consist of 3 replications of each treatment.

The research work with sheep to determine the best source of replacement ewes was continued.

Plateau Experiment Station

Crossville

Ill fortune marked the beginning of the year with the loss of the station's shop and storage building by fire, apparently caused by an exploded coal stove. The fire started in the night of February 11 with near zero weather and a driving snow storm. Considerable loss of machinery and equipment resulted, hampering the season's operation. Weather for the season was nearer normal than in recent years and crop studies were not particularly hindered. In fact, the late freeze helped to eliminate less hardy varieties of some crops under test.

Special meetings included a general Station Field Day in August and a Corn Harvest meeting in October in addition to many smaller groups with special interests.

Funds made available for further capital improvement made possible other seriously needed additions at Grasland Farm, including Assistant Superintendent's dwelling, further improvements to main cattle barn, completion of machine storage shed, installation of water system serving 3 dwellings and barn, and wiring of farm center. Improvements at the main

station included construction of a 32′ x 84′ tobacco barn, a 24′ x 60′ machine shed, and a new 42′ x 90′ shop and work center building.

Research projects at this station are carried on under the leadership of the Departments of Agronomy, Horticulture, and Animal Husbandry. Reports on this work are included within the department reports of this publication. The following general statements may add to these reports:

A study of phosphates in a 3-year rotation has completed 8 years. Fair measures of rock phosphate compared with super phosphates are being established. Two years of a rotation study with potash is beginning to give worthwhile information. Some varieties of alfalfa showed satisfactory stands at the end of 5 years' cutting. Narragansett maintained the best stand and yield of these in the test. Genessee wheat topped the variety yield test in 1955. Mo. 0-205 spring oats showed less susceptibility to rust than Columbian or fall oats seeded in spring and made significantly higher yields.

An apple variety test of 19 varieties has completed 6 years of growth. Vigorous growth in most varieties makes for a promising study. Irrigation equipment has been procured and work has been started on strawberry irrigation. Other horticultual crops will enter irrigation studies as facilities permit. Cauliflower production experience on this station in recent years indicates an opportunity for the ready market disposal of a limited acreage of cauliflower under irrigation. The grower could expect to wholesale a gross in excess of $500 per acre for the fall crop.

Southwest Texas ewes have been added this year to make the fifth source of ewes in the Source of Ewes Test. Comparison of herd records of the current grade Shorthorn herd show that productivity of cows has markedly declined in comparison with the cows in the herd 8 years ago which were sired by other bulls. Improved facilities make possible the carrying on of winter feeding and management studies with beef cattle at Grassland Farm and at the main station.

Tobacco Experiment Station

Greeneville

Abnormal weather conditions at this station in 1955 seriously affected all research projects.

An unseasonal freeze occurred during the period March 26-30. In this sustained cold period, when the temperature dropped to a low of 14 degrees and was below 20 for 19 hours, much damage was done to all growing crops. Most of the tobacco plants were killed and had to be reseeded. Pasture and hay crops suffered severely. Small grain crops were killed to the ground, and yields produced were the lowest in several years.

Rainfall was below normal in May, June, and July. Coupled with the drouth were higher temperatures than normal, especially in July. Corn, hay, and tobacco were all greatly damaged by the lack of rain. Below normal temperatures prevailed in October, November, and December which retarded the growth of fall-seeded crops.

The station purchased an adjoining tract of 11.3 acres on which was a seven room dwelling and a barn that will house 2 acres of tobacco. An additional tract of 3.65 acres was donated to the University for use by the station. The road that provides access to the Station and 4-H Club Camp was greatly improved. A new silo, 14 feet in diameter and 36 feet high, was constructed at the site selected for the proposed cattle shed and handling pens.

The beef cattle and sheep projects of last year were continued, and additional studies were made on drawfism in the purebred beef herd. An analysis of the data on daughters of the two highly bred Hereford bulls, used as foundation stock for starting the purebred herd at Greenville, is very discouraging. This project is in cooperation with the Department of Animal Husbandry-Veterinary Science, which includes a report on this work.

Attendance was good at each of the three field days held during the year. The annual meeting which emphasizes tobacco plant production was held in the early part of May. In addition to the tobacco plant bed work, visitors observed a demonstration of field choppers harvesting vetch-small grain silage. Three

different companies exhibited machines in this demonstration.

The annual summer field day was held on August 10. Excepting a short speaking program in early afternoon, visitors spent the day observing the experimental work on tobacco, corn, forage, and livestock.

Each year, at the close of the tobacco marketing season, a display of experimental tobacco is made at a local tobacco warehouse for the benefit of farmers, tobacco dealers, and others who may be interested. This year, interested persons observed the type of leaf produced by several experimental and commercial varieties and by various fertilization, irrigation, and sucker control treatments. This meeting draws attendance from Western North Carolina and Southwestern Virginia, as well as from Tennessee.

Fertilizer tests with burley tobacco were continued with emphasis on rates of nitrogen, phosphate, and potash and sources of nitrogen. Responses in both yield and quality of tobacco were obtained by applications up to 90 pounds nitrogen, 120 pounds phosphoric acid, and 240 pounds potash (K_2O). Nitrate of soda, ammonium sulfate, urea, and ammonium nitrate were found to be about equally satisfactory as nitrogen sources for tobacco.

The problem of controlling tobacco suckers by chemical means is still of special interest, and considerable work on that project was done in 1955. White mineral oil and maleic hydrazide have been used, but the behavior of these materials is erratic to the extent that neither is recommended for grower use.

For the second year an experiment was conducted on topping heights and suckering practices. Indications to date are that topping tobacco at a moderate height and keeping suckers removed is the most satisfactory treatment. Topping and suckering tobacco tend to increase the nicotine content of the plant. When tops and suckers are allowed to grow, however, the low-nicotine leaf obtained is compartively poor in yield and quality and less satisfactory to the manufacturer than when tops and suckers are removed.

An irrigation study was carried on in cooperation with the Agronomy Department. By applying approximately 5 inches of water in 4 applications, tobacco yields and returns were in-

creased. Much more study will be needed before any recommendations can be made.

Introductory seed of the variety Burley 21 released in 1955 has received good acceptance by growers. This variety is resistant to wildfire, mosaic, and black root rot. Continuing tests in the burley area indicate that it yields well and has good quality.

Five varieties under the name of Burley have been released cooperatively by the Tennessee Agricultural Experiment Station and the United States Department of Agriculture based on experimental work in Tennessee and other states. Burley 21 is the latest release. Burley 1, although not as widely planted now as formerly, is highly resistant to black root rot. It continues to be one of the best commercial varieties in acre returns in this state. Its chemical composition is highly desired by the cigarette manufacturers. Burley 2 is widely grown and well accepted by growers. It is resistant to black root rot and has a wide area of adaptation. Burley 11A and Burley 11B are the only two commercial burley varieties with root resistance to black shank. These two also have fusarium wilt and black root rot resistance.

Work continues on obtaining acceptable lines with resistance to black root rot, mosaic, wildfire, black shank, and fusarium wilt. Lines with low levels of nicotine and total alkaloids are being tested for growers and manufacturer acceptance.

For the second year, streptomycin has shown excellent preventive and curative action on wildfire in the plant beds. This material is now commercially available. All tobacco work at this station is with the aid of, and in cooperation with, the Agricultural Research Service, United States Department of Agriculture.

U-T, AEC Research

Oak Ridge

The research program of the UT-AEC laboratories is divided into studies on fission products, calcium and phosphorus absorption, excretion and retention; influence of irradiation on reproduction of cattle and whole body irradiation of cattle,

sheep, burros, swine and dogs; and the irradiation of seeds and plants.

The following summarizes the work during the year:

Studies on factors which influence calcium and strontium metabolism as measured by bone mineralization demonstrated that increased protein intake increases bone mineralization. Some proteolytic enzymes destroy the quality of proteins so that they do not increase bone mineralization. Increased calcium uptake results in deceased strontium rentention but does not change the ratio of calcium to strontium in the bone. The faster growing bones retain strontium as readily as calcium.

Cesium and potassium metabolism as related to natural feedstuffs was studied. An organic substance found in oats, wheat, soybean oil meal and alfalfa meal increases the fecal excretion of both potassium and cesium. Corn meal, milk protein and starch increases the urinary excretion of these minerals.

Fluorine is related to vitamin B_{12} and sulfur metabolism. In the rat, fluorine increases the uptake of inorganic sulfur whereas in the chick it is decreased. The sulfur amino acid and methionine reduces the toxicity of fluorine.

The availability of calcium and phosphorus from natural feedstuffs such as alfalfa meal, bone meal and hay was determined. They varied slightly but were considered to be similar.

Massive dosage of vitamin D was found to increase the blood calcium level. This increase appeared to be due to increased absorption from the gut.

Parathormone, when used in large amounts, caused calcium to be deposited in kidney tissue whereas cortisone brings about its removal.

Bulls which were irradiated with cobalt-60 gamma irradiation at levels of 100, 200, 300 and 400 r showed no appreciable change in semen characteristics during the first six weeks post irradiation. A change was observed, however, after the sixth week post-irradiation period.

Hogs weighing approximately 150 pounds were given graduated dosages of irradiation from Zr 95-Nb 95. All the hogs survived the LD 50/30 dosage. When given fractionated dosages of Co-60 gamma irradiation at the rate of 50r per day the

hogs survived over 10 times the expected LD 50/30 dosage level.

A new seed irradiation laboratory was constructed in which some plans were developed for irradiation of seeds for Southern plant laboratories.

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West Tennessee Experiment Station

Jackson

Weather conditions for the year 1955 were generally quite favorable to maximum summer crop production. A low temperature of 15° F. on March 26 was destructive to fruits, vegetables and winter field crops. The total rainfall for the year was 55.66 inches. Rainfall during February, March, April, May, and July was above average. July had an unusual rainfall of 12.97 inches.

Record yields were made on most summer crops. Conditions were quite satisfactory for comparing the productive capacity of crop varieties included in variety tests.

The station's building improvement, which was begun in 1954, was continued. The barns used for livestock work and plot barn were given a general repair, new siding, new roof, and outside trim painting. A new cottage was built for the farm foreman. The space in the office building used for many years for the farm foreman's residence will now be made into suitable office quarters for personnel of the Agricultural Extension Service, District One.

Modernization of 10 farm cottages was begun. The work includes addition of bath room and modern kitchen, new roof and siding, with outside painting. This work was not completed but is expected to be continued into 1956. The Horticulture greenhouse, auditorium, cattle feeding shed, and dining hall are other major buildings needing repair. Most of the buildings on this station were originally constructed in 1908. They are very much in need of modernization and general repair.

A survey for a U. S. Highway No. 45 by-pass through the station, following a route approved by the local Planning Commission, met with much opposition from agricultural interests

throughout Tennessee. The press and county agricultural groups in West Tennessee were particularly active in their opposition.

The station received the usual large number of visitors during the year. The three-day summer Institute, sponsored by the station, was well attended. The study was limited to the research underway with field crops, livestock and farm machinery. The facilities of the station were used for many small meetings. Much interest was shown in the newly instituted Field Day for observing the harvest of the Station's Corn Variety Test. This meeting was sponsored by the Agronomy Section of the Agricultural Extension Service.

The overall program of research at this station was expanded during the year. This required considerable special equipment and facilities. A new well and pump for research in irrigation was put into operation. Several pieces of labor-saving equipment were purchased. Three new bulls and eight heifers were purchased from the highest producing strains of Jersey Cattle in the United States to be added to the Dairy Cattle Breeding project.

Active research programs are underway with: agronomy—field crops, fertilizers, and soils; livestock—dairy cattle and swine breeding, feeding and management; horticulture—fruits and vegetables, with particular emphasis on strawberry and tomato breeding work for the development of more suitable varieties; entomology—spray programs and seed treatment for controlling cotton insects; pathology—variety development and fungicide testing for control of plant diseases, study of nematodes and their relation to plant disease problems of Tennessee.

More detailed reports of the research work may be found under the reports of the respective departments.

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AGRICULTURAL EXPERIMENT STATION
KNOXVILLE, TENNESSEE

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